DOCTORAL THESIS

Environmental Auditing: Modelling Office Workplace Ecology

Al-Khawaja, Abdallah

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ENVIRONMENTAL AUDITING:
Modelling Office Workplace Ecology

Abdallah Al-khawaja

Faculty of Society & Design
Bond University
Gold Coast, Queensland
Australia

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Declaration

This thesis is submitted to Bond University in fulfilment of the requirements of the degree of Doctor of Philosophy. This thesis represents my own original work towards this research degree and contains no material which has been previously submitted for a degree or diploma at this University or any other institution, except where due acknowledgement is made.

25/02/2015

Abdallah Al-khawaja Date

Abstract

Climate change is one of the greatest environmental challenges facing the world today. Australians will also be affected by the phenomenon, especially those residing in coastal areas, where most of our capital cities are located. As we know in the last three decades of the Twentieth Century we have seen, and will continue to see, a growing interest in ecology and increasing attention in the protection of the environment. This interest can be translated into the built environment and the ecology of the workplace.

This thesis makes the case for workplace ecology and builds a unique framework based on the principles of environmental auditing in the context of organisation, space and technology provision. This framework highlights the relationship between organisation, space and technology domains via the quantification of workforce satisfaction, comfort and productivity respectively, and will assist in measuring the success of business enterprise to create 'healthy' work environments for their people.

The assessment of workplace ecology in this thesis is achieved by using a structured survey of participants in the workplace, at all levels of responsibility, to determine an overall consensus of satisfaction, comfort and productivity specific to an individual in the context of their job responsibility and its inherent complexity. An analysis of the findings indicates that besides building typology and standard there are other important factors influencing workplace ecology. This research makes a significant contribution to the

current body of literature by demonstrating the nature and strength of relationships as well as a means of assessing overall workplace performance as an arithmetic mean of individual perception. The connection between satisfaction and comfort can be alternatively defined as 'happiness', the connection between satisfaction and productivity as 'empowerment', and the connection between comfort and productivity as 'efficiency'.

Overall there is a suggestion that the relationship between comfort and satisfaction and between comfort and productivity are of moderate strength, positive and significant, adding weight to common arguments like "successful green buildings lead to happier and more productive workers". However, in this research the green case study was out-performed by all of the non-green case studies for virtually all of the key factors examined. The reasons behind this outcome need to be further explored.

Workplace ecology, just like environmental ecology, is a balance of factors that contribute to the sustainability of an 'eco-system' that is fundamental to corporate success and continuous improvement. This research develops a 5-star rating system for office workplaces based on an environmental audit procedure integrating organisational, spatial and technological attributes into a novel workplace ecology model.

[419 words]

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I am truly thankful to my parents Deeb & Maha, brother and sisters and my wonderful wife Marwa, whom encouraged me to complete this project. Mom and Dad, you are wonderful parents and amazing friends. And Marwa, if I wrote down everything I ever wanted in a wife and best friend I would not have believed I would ever meet such a person! All of your continued encouraging support is very much appreciated.

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Contents

List of Tables

List of Figures

List of Abbreviations

AGBR	Australian Building Greenhouse Rating
BREEAM	Building Research Establishment Environment Assessment Method
CBD	Central Business District
CI	Continuous Improvement
DV	Dependent Variable
ELAP	Frameworks for Environmental Legitimacy, Accountability and Proactivity
EMS	Environment Management Systems
FM	Facility Management
GBCA	Green Building Council of Australia
GHG	Greenhouse Gas
HOPE	Optimisation Protocol for Energy-efficient Buildings
HRM	Human Resource Management
IAQ	Indoor Air Quality

ICT	Information and Computer Technology
IEQ	Indoor Environmental Quality
ISO	International Organisation for Standardisation
IT	Information Technology
IV	Independent Variable
JCPA	Joint Committee on Public Accounts
LEED	Leadership in Energy and Environmental Design
OE	Organisational Ecology
POE	Post-occupancy Evaluation
SBS	Sick Building Syndrome
SEA	Social and Environmental Accountability
SEM	Structured Equation Modelling
TQM	Total Quality Management
USGBC	U.S. Green Building Council
WEI	Workplace Ecology Index
WEM	Workplace Ecology Model
WPI	Workplace Performance Index

CHAPTER 1:
Introduction

1.1 Rationale

There is a significant interest from the public, governments and global organisations in environmental management (Wijesooriya, 2013). This interest is reflected in the improved acceptance of globally recognised environmental management approaches, increased environmental legislative changes, and pressure on companies to satisfy legislative requirements. However, the focus will progressively shift to environmental auditing due to the need for a useful tool that can be used to evaluate management system implications and on-going environmental compliance. Environmental auditing is often thought of as a management tool employed by businesses to better manage the progress of their environmental performance (Hillary, 2010). Environmental auditing can also investigate the effectiveness of past environmental impact assessments in an attempt to find ways of improving the value and efficiency of future assessments (Bailey *et al.,* 1997; Whitfield & Robinson, 2010). Environmental auditing is necessary because it creates awareness about environmental problems in organisations in order to help the relevant individuals to identify and solve environmental problems, which may improve the performance of individuals. Despite the importance of environmental auditing, there is no framework in the literature that has been tested using this study's criteria (i.e. organisation, space and technology).

There is a need to create a method for assessing the performance of office workplace ecosystems as a means of continuous process improvement. This

study creates a new framework of environmental auditing related to built assets occupied by Australian companies in the context of the surrounding conditions in which a worker must operate. Furthermore, this study explores the relationship between organisation, space and technology, seen as the 'triple bottom line' of workplace ecology. This framework is called the Workplace Ecology Model (WEM) and it will describe the conditions present in an environmental setting that are conducive to happiness, efficiency and empowerment of office workers.

This chapter provides an introduction to this research. Section 1.2 presents the problem statement for the study and Section 1.3 discusses the research aims. Section 1.4 introduces the research questions, while Section 1.5 identifies the significance of the study's scope. Finally, section 1.6 briefly describes the structure of the thesis.

1.2 Problem Statement

In the last three decades there has been a growing interest in environmental issues and increasing attention placed on the protection of the environment. This has led to a focus on attaining an ecological balance to ensure continuous long-term development and the maintenance of current living standards. Furthermore, climate change is one of the greatest environmental challenges facing the world today, as increasing amounts of carbon emissions entering into the atmosphere contribute significantly to the rise of the average global temperature via a 'greenhouse' phenomenon. Buildings and development provide countless benefits to society, but they also have significant environmental and health impacts.

According to Yan *et al.* (2010), approximately 70 per cent of all global greenhouse gas (GHG) emissions are from buildings. For example, the construction of buildings has a considerable impact on the environment. The process of manufacturing and transporting of building materials and constructing buildings consumes a great amount of energy and emits large quantities of GHG. Many previous studies have focused on the climatic impact that buildings have on occupants, their satisfaction and performance (e.g. Frontczak *et al.,* 2012). A study by Altomontr & Schiavon (2013) investigated occupant satisfaction levels within green and non-green buildings. The

researchers found that satisfaction with air quality was slightly higher in green offices than non-green offices, but the satisfaction with the amount of light was slightly lower in green offices. The focus on issues of comfort has dominated previous built environment research related to environmental auditing.

There is no viable framework that integrates comfort with other aspects of occupancy performance for built assets. It is well understood that continuous process improvement is an effective way to work on achieving goals and to improve business performance by learning from past mistakes, but the relationship between the factors involved is complex. Despite the fact that continuous improvement is a good way for organisations to excel, this business strategy does come with its own set of weaknesses. For instance, for training workers to operate in a continuous improvement environment takes time and money.

This research helps address the weakness of previous literature concerning office workplace performance and evaluation methodologies. Modern office settings are used as a context to assess the performance of workplace ecosystems and better understand the key determinants of workplace ecology.

1.3 Research Aims

The overarching aim of this study therefore is to develop and test a method for assessing the performance of office workplace ecosystems in order to implement continuous improvement (CI). This research aim can be broken down into the following objectives:

1) To review the existing literature concerning office workplace performance and evaluation methodologies.
2) To conceptualise a new framework for integrating the key determinants of workplace ecology.
3) To develop a method to assess the performance of office workplace ecosystems.
4) To collect case study data to test the method for a representative range of office building typologies.
5) To analyse data to identify areas of potential improvement and to evaluate and rank overall workplace performance.

6) To test specific research propositions that explore the relationships between key determinants.
7) To identify implications for practice and further research opportunities.

The plan for this research as agreed at the outset is shown in Figure 1.1. It provided a guide over subsequent years, even though the intricacies of the research were constantly evolving.

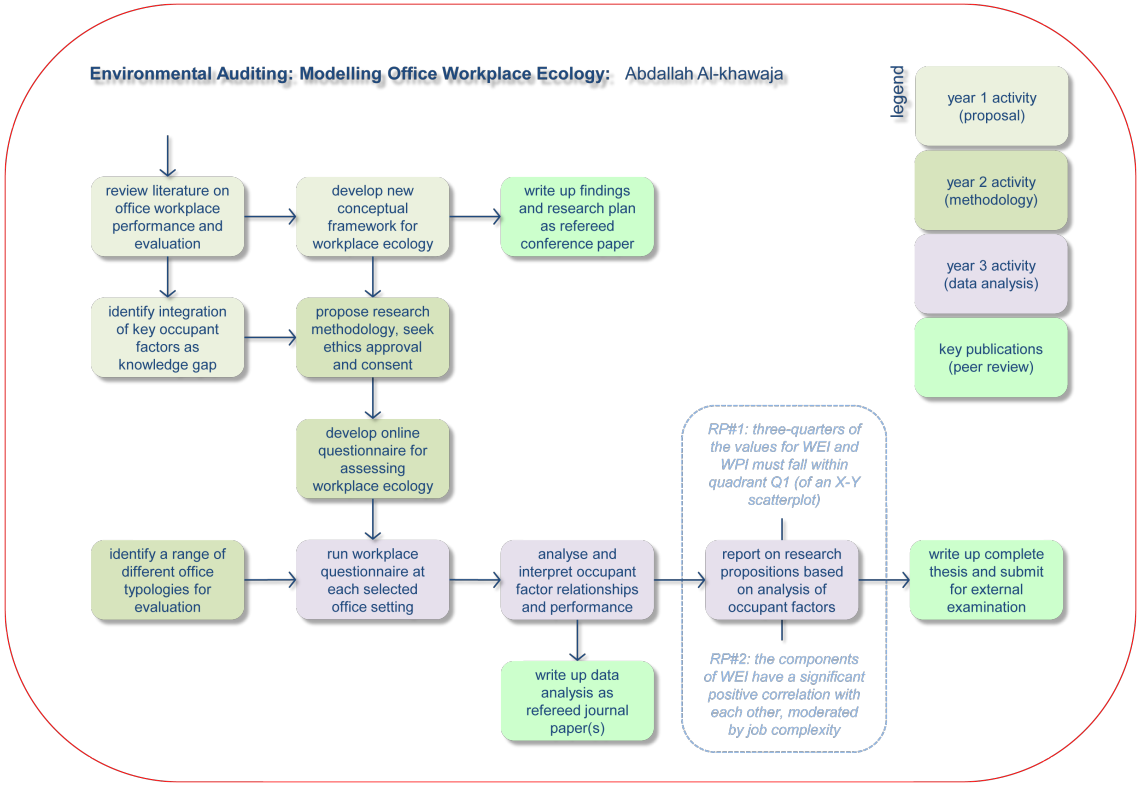

Figure 1. 1 Research Plan

1.4 Research Propositions

As part of this research, two research propositions are advanced to provide a greater level of insight into workplace ecology performance:

- *RP #1 (Healthy Ecosystems):* At least three-quarters of the values for Workplace Ecology Index (WEI) and Workplace Performance Index (WPI) must fall within quadrant Q1 (see Figure 1.2) for a balanced work 'ecosystem'.

- *RP #2 (Ecosystem Attributes):* The components of Workplace Ecology Index (WEI) have a significant positive correlation with each other, moderated by job complexity.

WEI and WPI are two indices derived from occupant surveys of office workplaces. WEI refers to the combination of satisfaction, comfort and productivity determinants, while WPI refers to the expectations placed on office workers in the context of the complexity of their job description. Both indices are expressed as a single numeric score within the range -10 to +10. Positive values in both cases suggest acceptable performance benchmarks have been achieved, and ecology is in balance with business activity for the majority of workers.

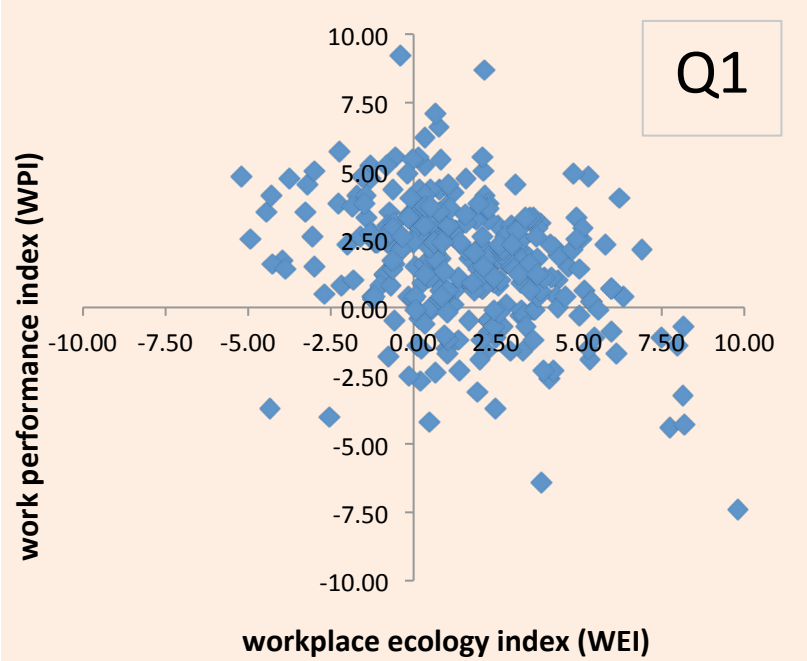

Figure 1. 2 Research Proposition #1
Source: author

1.5 The Significance of this Study

When looking at environmental responsibility, there are many different ideas as to how businesses can learn to be more environmentally aware with a focus on worker satisfaction, comfort and productivity. Due to external and internal pressures, many businesses have starting to realise that they must do more to help the environment and reduce the ways in which they negatively affect the planet. Also, profits are no longer used as a comprehensive performance

evaluation metric; companies should also do a thorough analysis of the social impact of their firm and provide adequate data about costs, social benefits and corporate responsibility (Gray, 2008). Adopting such a process in business is costly but may change the way people do their jobs in a particular field, thus helping businesses to achieve their high level goals. Workplace ecology underpins these aspirations.

An integral part of any organisation is its employees. The workplace influences the productivity of employees (Hoel *et al.,* 2011), thus affecting the business and its financial performance. This study contributes to establishing the extent of the importance of post-occupancy evaluation (POE) via a new framework for workplace design and management. This study shows the relationship between environmental audit techniques, POE and business performance through a continuous improvement strategy for office settings in Australia. The findings of this study help to better understand office workplace ecosystems, which can be improved by routinely adopting the WEM framework. Australian business disciplines, including managers, accountants, architects, facility executives and auditors will benefit from the results of this study.

The proposed WEM combines POE techniques with the accepted philosophy of CI. In order to effectively conduct the research and test the framework, thereby achieving the research aim, a quantitative methodology is employed. Modern examples of office buildings are used as case studies to explore the proposed method and test its application in practice. Heritage-listed and newly renovated older buildings are not included in the study, but may be an area of future research, particularly in regard to 'before' and 'after' transformations that might illustrate continuous process improvement in action.

The case studies comprise the following office settings:

- 1 pilot study: Bond University Sustainable Development Building (Green Star 6 building)
- 1 recent Green Star 6 building (cool temperate climate)
- 1 older low quality non-green building (in need of refurbishment)
- 1 recent high quality non-green building (CBD location)
- 1 older medium quality non-green building (regional location)

The case studies are used to illustrate application of the framework, not to benchmark building typologies. The identity of each case study is must be kept confidential owing to the sensitivity of some of the findings. Generally gaining access for POE activities was found to be problematic, and many advances to organisations were declined.

1.6 Format of the Thesis

This thesis is structured into seven chapters, including this one.

Chapter 2 is arranged in a logical sequence, using the concept of an inverted pyramid in order to present a better understanding of the underpinning literature. This chapter provides a background review that frames the research. POE and its definitions are discussed and then explanations of the historical development of POE, method types, applications and problems are provided. Attention is then paid to the terms environmental auditing, international standards, environmental management systems and the ELAP model which was used as inspiration for the model advanced herein. Some examples about how the concepts of environmental auditing are applied to buildings and the legal requirements involved are also included.

The review of the literature then examines the concepts of sustainability and green buildings by focusing on standards such as the Green Star rating system. Environmental performance and occupant feedback, including occupant comfort and wellbeing, are explored through a variety of related topics such as thermal performance, ventilation and indoor air quality, lighting and glare, acoustics, 'healthy' building syndrome, spatial design and privacy, and ergonomics. Then the literature related to the meaning of satisfaction and productivity of people and their work complexity is examined. The last topic of this chapter centres on the main research problem of workplace ecology assessment, and the three related drivers of performance: organisation, space and technology. The previous sections are opportunities to reflect and summarise what might be drawn from these interwoven streams, what findings can be revealed and what further questions might be relevant for the overall research theme.

Chapter 3 conceptualises a new framework for integrating the key determinants of workplace ecology and develops a method to assess the

performance of office workplace ecosystems. This chapter provides information on the research conceptual framework, which discusses the knowledge gap, the workplace ecology model, the idea of happiness, efficiency and empowerment, WEI and WPI, the continuous process improvement cycle, and the research propositions and hypotheses for testing. Further information on the initial development of the model is contained in Appendix 1.

Chapter 4 concerns the research methodology and focuses on the choice of questionnaire survey to collect data and the selection of case studies as demonstrators. This chapter provides information on the design of the questionnaire, the pilot study, the use of the SurveyMonkey™ online tool to collect data, ethics approval, and the method of hypothesis testing and validation to be used. Further information about the questionnaire design is contained in Appendix 2.

Chapter 5 comprises the analysis of the data collected, including respondent demographics, descriptive statistics, the four-quadrant model test, regression analyses, and structured equation modelling (SEM). Further information about the data is contained in Appendix 3.

Chapter 6 focuses on discussion and interpretation of the research results, which link back to what others have found and reported in the literature. It also addresses what can be learnt from the case studies and why some case cases have stronger hypothesis correlations than others.

Chapter 7 comprises the conclusion and summary of the work that explains the significance of the study, how the objectives have been achieved, and the limitations or possible bias in the work (and how these were minimised), together with suggestions for further research.

This research is expected to continue as an external funding opportunity to explore larger workplace datasets, as journal publications describing research findings to the wider community, and hopefully as commercialisation of the WEM framework and assessment procedures to embed this research into practice.

CHAPTER 2:

Literature Review

This chapter provides a background review that underpins the research. POE and its definitions are discussed and then explanations of the historical development of POE, method types, applications and problems are provided. Attention is then paid to the topics of environmental auditing, international standards, environmental management systems and the ELAP model, which was used as inspiration for the model advanced herein. Some examples about how the concepts of environmental auditing are applied to buildings and the legal requirements involved are also included.

The review of the literature then examines the concepts of sustainability and green buildings by focusing on standards such as the Australian Green Star rating system. Environmental performance and occupant feedback, including occupant comfort and wellbeing, are explored through a variety of related topics such as thermal performance, ventilation and indoor air quality, lighting and glare, acoustics, 'healthy' building syndrome (the opposite of sick building syndrome), spatial design and privacy, and ergonomics. Then the literature related to the meaning of satisfaction and productivity of people and their job complexity is examined. The last part of this chapter centres on the main research problem of workplace ecology assessment, and the three related drivers of performance: organisation, space and technology. The previous sections are opportunities to reflect and summarise what might be drawn from these interwoven streams, what findings can be revealed and what further questions might be relevant for the overall research theme.

This chapter provides a literature review on the thesis topic of workplace ecology. Section 2.1 defines POE and discusses their history and identifies the different types. Section 2.2 summarises the meaning of environmental auditing, while Section 2.3 provides details about the terms 'sustainability' and 'green building'. Section 2.4 examines occupant comfort and wellbeing and Section 2.5 explains the importance of job satisfaction and productivity. Section 2.6 describes job complexity in terms of the workplace and Section 2.7 summarises and investigates the literature concerning workplace ecology. Together these help to understand the factors at play in the modern office workplace.

2.1 Post-occupancy Evaluation (POE)

This thesis studies the effect of workplace ecology on employee performance. A central component of this research is using a post-occupancy style evaluation to determine the different key issues in assessing the performance of office workplace ecosystems, from the perspective of the organisation's workforce, as a means of continuous process improvement. This section explores the concept of POE by providing related definitions from previous studies.

2.1.1 Definition

The term POE was first used in 1960 in the United States for providing feedback on how successful the workplace is in supporting the occupying organisation and individual end-user requirements. Since then it has been adopted by different groups and used to evaluate building and organisation performance. The RIBA Research Steering Group (RIBA, 1991: p.191) defined a POE as "a systematic study of a building in use to provide architects with information about the performance of their designs and building owners and users with guidelines to achieve the best out of what they already have."

Preiser *et al.* (1988) asserted that "POE is the process of evaluating buildings in a systematic and rigorous manner after they have been built and occupied for some time" and that the different variants in the definitions of POE are derived from this idea. Vischer (2001: p.23) further clarified the definition of POE as "any and all activities that originate out of an interest in learning how a building performs once it is built, including if and how well it has met expectations".

As an evaluation tool, POE can be applied and utilised by construction business professionals or by the building owners or the customers themselves to do the evaluations. This function is identified by Preiser (1995: p.19), who further defined POE as "a diagnostic tool and system which allows facility managers to identify and evaluate critical aspects of building performance systematically".

The concept of the POE has not changed substantially since its development in 1960s. One of the key functions of POE concepts is centred on identifying the successes and failures of what has been implemented so far. For instance, research by Khair *et al.* (2012) defined POE as a "tool that is used to acquire feedback towards building performance that has been occupied." The next section will highlight the historical development of POE in order to understand the developments that have occurred concerning the use of POE as a measurement tool for assets. This retrospective look at POE provides a basis for improvements in the future.

2.1.2 Historical Development

In the 1980s there were incremental advances in the theory, strategy, method and application of POE. This was a result of the increasing interest from academics and constructors in POE that affected the levels of accountability for both managers and designers (Kooymans & Haylock, 2006). Deficiency of scientific exploration regarding the success and failures of past projects has been identified as one of the disappointments for POE. It was put forward by Cooper (2001) that this was well understood by architectural organisations in the UK during the progress of POE through the RIBA's complementary study to the qualified practice of architecture (Cooper, 2001: p.159). The escalating concentration on POE swiftly vaporised because of its inability to be incorporated into an architect's normal services and the worries about fees. The concluding phase of RIBA's handbook "Plan of Work (Stage M)" is devoted solely to feedback. This method of assessment was regarded as "the most cost effective way of improving service to future clients" (Hadjri & Crozier, 2009: p.23).

Another development was the rise of the environmental psychologist. By implementing scientific awareness, a POE project can perish under the care

and nurture of environmental psychology, as raised by Cooper (2001: p.159). As the interest in POE by the architectural profession decreased, it was left to other interested academic parties to progress the POE initiative. However, what is applicable from an architectural point of view is not the objective of the environmental psychologist, and threatened collapse of the entire idea from achieving its own objectives (De Young, 2013).

An environmental psychologist proposed that the stagnation in the development of POE research was caused by misunderstandings when the researchers concluded their study (Hadjri & Crozier, 2009). The environmental psychologists focus on building "utilisation" and use POE to measure that. This has consequently led to the notion, especially in the architectural community, that POE has at best played an external or trivial part in design improvement (Canter, 1984: p.42). A proper explanation of the poor progress of POE under environmental psychology is provided by Hadjri & Crozier (2009).

Canter (1984: p.43) contended that POE particularly and social science generally are essential components of the design process and should be a dynamic part of it. If the process is devoid of such a positive feat, "post-occupancy evaluation can do very little to influence the use of existing buildings and probably even less to future building designs". As Canter (1984: p.43) further explained, "the concept of feedback implies a commitment to measurement without involvement in the consequences of those measurements". Existing masters courses in the field of construction and project management regard building performance (including POE) and facility management (FM) as vital pieces of detail that should be valued. The field is still expanding and being deficient in a conceptual or theoretical framework gives reason for FM to be misread (McLennan, 2004: p.344).

The researcher has found that there has been a lack of evidence about how well buildings perform in the past because of the existing evaluation system for buildings in use. In the present day, the field of occupancy evaluation and feedback is rapidly expanding to address the need of assets evaluation, which is now a legal global requirement. Furthermore, reviewing the history of POE gives the researcher an understanding of the position of the subject of the thesis in relation to architectural concerns. The next section examines the existing types of POE in current practice.

2.1.3 Types of POE

In order to be able to approach the various situations required to carry out a POE, many different procedures have been developed. The surveys that have been conducted regarding the subject of POE approaches primarily categorise these procedures on a thematic basis. Three varying methods of application derived by Preiser (1995) condense the application of POE to different projects that range from the total procurement agenda of a whole project to their smallest aspects into three tactics: indicative, investigative and diagnostic POE (Preiser, 1995; Preiser *et al.,* 1988).

1) *Indicative*: These are brief and hasty examinations regarding indicative POE that may accommodate "quick walkthrough evaluations involving structured interviews with key personnel, group meetings with end-users as well as inspections" (Preiser, 1995: p.21).
2) *Investigative*: Investigative POE incorporates very lengthy and precise evaluation tests that are comprised of questionnaires and interviews that are directed at buildings that are comparable or of identical kind. Their accuracy is also considered to be more reliable than the indicative POE.
3) *Diagnostic*: POE and its results are capable of delivering "high validity and generalisability of data collected [that has] the potential of being transformed into guidelines" for use in the public realm (Preiser, 1995: p.53). Their wide spectrum analytical research and very diverse examination techniques are focused on areas that hold interest regarding anthropology and availability of many comparable facilities, Diagnostic POE is considered to be the most advanced of the available strategies.

A further perspective on POE by Vischer (2001: p.32) highlighted four general typologies, as follows:

1) Building-behaviour research, or the accumulation of knowledge;

2) Information for pre-design programming for buildings for which design guides or prototypes may be useful;

3) Strategic space planning – i.e. building assessment as part of modern workspace change to bring space more in line with strategic business goals; and

4) Capital asset management – POE as a tool in developing performance measures for built space.

Another recent study by Riley *et al.* (2009) found that there is more than one approach or method for POE and the methods selected should be decided upon depending on the needs of those doing the evaluation. For instance, KODO Probe is a tool that was developed in Australia in 2008 as a method for gathering meaningful data and information in terms of how buildings in use impact on the attraction/retention, comfort, health and wellbeing, satisfaction and productivity of those who actually occupy and use them. KODO Probe is discussed in more detail in the following section.

There are more than 150 POE techniques available worldwide (Riley *et al.,* 2009). For instance, POE regularly includes a mix of quantitative and qualitative techniques. Nearly all POEs involve looking for feedback from the occupants of the place being evaluated, which may be accomplished by using various survey methodologies including questionnaires, interviews or focus groups. Occupant feedback may be supplemented by environmental monitoring, like noise levels, temperature, lighting levels and indoor air quality. In recent times, POEs tend to include sustainable measures like waste levels, energy consumption and water usage. Some others use quantitative measures including space metrics, for instance occupational density and space utilisation (Brown, 2009; Riley *et al.,* 2009).

The proposed framework in this research is based on qualitative opinion, merging POE techniques with CI by obtaining feedback from occupants in a range of office case studies. However, Riley *et al.* (2009) found that the perceptions of the value and efficacy of POE are established strongly in specific areas of facility management (FM). Existing POE methods and the techniques used for each method are summarised by Riley *et al.* (2009) as follows:

1) *De Montfort Method*, which uses walkthrough techniques and broadly focuses on process review and functional performance.

2) *Overall Liking Score*, which based on questionnaire techniques with focus on functionality and building quality/impact, often using a Likert scale for assessment.
3) *PROBE Method*, which uses more than one technique such as questionnaires, focus groups and visual surveys, where this method is centred on user satisfaction by occupant survey, systems performance, benchmarks developed, energy assessment and evaluation performance of systems.
4) *BUS Occupant Survey*, which uses two techniques: building walk-throughs and questionnaires backed up by focus groups (this method is centred on occupant satisfaction and productivity).
5) *Energy Assessment and Reporting Methodology*, which uses two techniques: energy use survey and data collection (e.g. from energy bills).
6) *Learning from Experience Method*, which is founded on facilitated group discussions or interviews (including cross-sectional team learning experiences).

There are two key aspects measured under POE. The first is the technical performance of the building itself, such as the built environment performance, which also has two characteristics: resource consumption efficiency and environmental impacts. The second is the functional performance of the built environment with respect to the occupants (both the organisation and individuals). POE often struggles for legitimacy due to the challenges of consistency in measurement outcomes, hence the importance of the ability to benchmark for comparison purposes and performance improvement, and rigorous measurement. Often these POE surveys revert to evaluations of occupant satisfaction and the assumption that more satisfaction equates to better performance outcomes.

As shown above, POEs are flexible enough especially in terms of scale, resources, goals, methods, evaluator expertise, and evaluator interests. However, POE methods are focused mainly on four key drivers: defining goals, data collection, data analysis, and outcomes presentation. Additionally, the previous review of POE methods and techniques suggests that there is no

single method for evaluating assets and occupants in the same time and this can influence delivery of key business objectives.

2.1.4 Application of POE

The theory, method, strategy and application of POE have evolved slowly since the early 1980s. These were as a result of the increasing interest in POE and higher levels of accountability for both managers and designers (Riley *et al.,* 2009). The importance for evaluating projects in the United Kingdom emerged in the late 1960s because of government regulation. It was a fertile environment for researchers at the University of Strathclyde, which was one of the first universities to do evaluations. The purpose was for the university to publish the results of the evaluations and obtain feedback on building performance for teaching and design (Preiser & Vischer, 2005). Riley *et al.* (2009) criticised the feedback and evaluation carried out by the university, as their focus was on research rather than actually developing practical plans and this was found by Riley *et al.* (2009) to be a barrier to it becoming a mainstream process.

The concept of POE was again embraced in 1994 when the UK Government funded building research. In the same year, a team was put together as a broader organisation called Probe with the objective of publishing POEs on newly constructed buildings, (Preiser & Vischer, 2005). Cooper (2001) found that more than 20 studies on POE were published between 1995-2002 and since then POEs have also started to be used in the United States.

A recent study by Agha-Hossein (2013) on POE explored how physical workplace environment affects employees' satisfaction by using pre-occupancy and post-occupancy evaluation studies. The study considered both energy consumption and employee perceptions, to make comparisons between a company's former and current headquarters. In the result of office employer's self-reported productivity, well-being and enjoyment at work improved after the move. It was shown that the best predictor of the perceived productivity was the combination of employee's level of satisfaction with "interior use of space" and "physical conditions", however "indoor facilities" were not seen as a good predictor. In terms of energy performance, even though the new office's energy consumption was significantly less than that of the previous building,

there was still a slight gap in the actual performance of the building and the renovated design target. Concluding this point, the findings suggest that this gap could be due to multiple factors, such as an ineffective use of interior space and occupants' behaviour and attitudes.

Another recent study on sustainable building by Guerin *et al.* (2012) used 200 POE surveys to evaluate employees' work performance and satisfaction relating to sustainable design criteria. The Guerin study found that there was a positive correlation between employee satisfaction with the new facility (site, building, and interior) and employee performance and productivity.

2.1.5 PROBE Studies

The prominent frameworks for POE include PROBE UK (focusing on building engineering with additional questions concerning occupant satisfaction and perceived productivity) and KODO Probe (focusing on health, pleasure and performance of occupants), which fall within the gambit of this thesis.

Probe is a method for POE providing feedback on generic and specific information on factors for success in the design, construction, operation and use of buildings, together with areas of difficulty and disappointment (Cohen *et al.,* 2001). It was first applied to buildings that were constructed in the UK in 1995 (Leaman & Bordass, 2001). The research from Probe gave feedback about buildings that were in use by residents and helped the building industry, their clients and government to make amendments improving the technical performance of buildings as well as maximising occupant satisfaction. These studies also helped to find ways to reduce the building's impact on the environment (Bordass *et al.,* 2001).

The assessment of energy performance is an important aspect of Probe studies, as it is a requirement that buildings under construction in UK should be designed in a way that will optimise energy utilisation efficiency (Bordass *et al.,* 2011).

In 1995, the Probe project was started as a joint venture between the UK Government (Department of Environment, Transport and the Regions), a publisher and a research team. POE surveys of new commercial and public buildings were conducted by Probe about two to three years after completion.

These aimed to provide feedback on factors that affected design, operation, construction and use of buildings along with identified problem areas (Bordass *et al.,* 2001).

It was shown by the Probe projects that anyone can conduct the surveys to create awareness among building industrialists and clients. The UK building industry was being forced by government to make improvements in product quality, delivery and sustainability (Bordass *et al.,* 2001). The Probe surveys were done by investigating the public response to indoor environments and included studies of the survey's consequences and future improvement plans (Leaman & Bordass, 2001).

There are two summary indices which are now being used by Probe. The first is based on comfort (i.e. scores for summer and winter temperature, air quality, lighting, noise) and the second is based on satisfaction (i.e. ratings for design, needs, productivity and health). Both indices can be combined (Bordass *et al.,* 2011).

Building service design engineers were originally targeted by Probe but now it has gained popularity in other domains. The Probe team consists of members who belong to different consultancies who provide feedback services to clients to assist with the business process. However, Probe itself is a public service that is concerned with generalities rather than specialties in the building design process. It focuses on strategies which can help improve building performance and it should be used by designers and, most importantly, by engineers (Bordass *et al.,* 2002).

A typical office organisation should focus on attributes such as design, management, and use of the indoor environment. There is a strong association between perceived productivity and many factors such as comfort, health and customer satisfaction. Some other factors that ensure the success of building performance are management, design and characteristics, which help improve energy efficiency and productivity. Consequently, they help close the loop on a potential virtuous circle (Leaman & Bordass, 1999).

The results published by Probe were very informative and insightful (Cohen *et al.,* 2001) and all the work was performed within the given limited budget range. It pointed out the factors that lead to success in the building industry were often related to the processes of procuring, occupying and managing a building along with the roles of all the parties involved. Highly experienced assessors are the key to Probe's procedure success.

This research uncovered another similar method, KODO Probe, which is used in Australia. The environmental expectations of buildings may not always be returned as sometimes the performance exceeds our expectations while at other times it falls short. The probability of problems is high regardless of the best efforts and intentions of designers and managers. So, in order to derive the most optimum outcomes, special focus and attention needs to be applied (Government of South Australia, 2008).

By taking into account the facts and factors that have an implication on the health, pleasure and performance of occupants, KODO Probe seeks to produce a work performance profile. Areas like the results for the base building, tenancy, design of workspaces and management of change are addressed by KODO Probe (Government of South Australia, 2008).

Previous studies have shown a weakness concerning the Probe studies. There are no adequate studies to support or argue what has been found previously in relation to Probe studies. Additionally, Probe studies have been applied mostly to UK buildings. This is counted to be a weakness, as it may have limited its applicability to other parts of the world. More research is needed to improve POE surveys and the methodology of performance assessment.

2.1.6 Implementation Issues and Barriers

Firstly, regarding the implications of POE, a study by Hadjri & Crozier (2009) found that applying POE has many benefits, including employing design ability more efficiently,; ameliorating the commissioning process, improving customer demands, improving management procedures, assisting in the provision of information for design guides and regulatory processes, and the targeting of renovation. The main purpose behind using a POE is to provide significant information to assist in the objective of implementing relentless development as suggested by Zimmerman & Martin (2001). However, the

overarching benefit is to support the goal of continuous improvement, which can be a tool for improving business performance. The results from POEs must inform decisions concerning whether to make corrections or changes to better suit the needs of the users or occupants.

Literature has acknowledged several testimonials from those who are willing to commence a POE process. Although there may be quite a lot of theories regarding the process of POE, most of them have relied on contextual matters and necessary results. To accomplish this, there is a three-phase procedure of planning, setting up capacities and other requirements for the analysis: execution (collection of data, interviews, questionnaires and direct observation), examination and demonstration (statistical analysis, technical performance, dissemination in a series of workshops, and reports). They also comprise the need to merge qualitative and quantitative datasets (Vischer, 2001). Standardised collection feedback protocols suggest that "similar data should be determined through the process of cautiously chosen and recognised indicators of environmental excellence" (Vischer, 2001: p.33).

Lastly, to help endorse the appropriate application of POE, it is first necessary to distinguish the obstructions regarding the extensive embrace of POE, such as cost, protecting professional wholeness, time and ability. Likewise, there are obstructions that prevent the extensive implementation of POE: the "lack of agreed and reliable indicators, exclusion from current delivery expectations [and] exclusion from professional curricula and fragmented incentives and benefits within the procurement and operation processes" (Zimmerman & Martin, 2001: p.168).

POE is not included as a component of an architect's "usual avails" to the client. Therefore, clients are unlikely to spend money on a POE unless the returns of such appraisals are obviously noticeable and considerable in worth (Cooper, 2001). Bordass *et al.* (2001) identify this problem of cost and willingness to pay for POE; noting that the cost is not just to conduct a POE survey but also to execute the findings and results.

This section examined the literature on POE. The next section discusses the concept of environmental auditing. This term can reflect various types of evaluations and, in this research, environmental auditing will be applied as a specific instance of POE.

2.2 Environmental Auditing

This thesis studies the effect of workplace ecology on employee performance by testing a framework related to the environmental auditing criteria. The WEM framework helps to determine the different key issues for each of the research's case studies. The term 'environmental auditing' has been used to meet the research's aims and objectives by developing and testing a method for assessing the performance of office workplace ecosystems as a means of continuous process improvement. This section explores the concept of environmental auditing by reviewing the relevant definitions from previous studies.

Growing public awareness about climate change has caused both governments and organisations to realise that there are severe consequences due to climate change-related environmental deterioration. Environmental auditing assesses the nature and risk of harm to an environment posed by an industrial process or activity, waste, substance or noise. Cave & Brown (2012: p.105) defined environmental auditing as "a management tool which determines the actual and potential environmental impacts of both public and private sector activities". First developed in the 1990s, the study of environmental auditing has grown quickly in Western countries and much relevant research has been conducted simultaneously (Li *et al.,* 2011). In this study, the environmental auditing literature has been reviewed in order to build a framework capable of finding the environmental strengths and weaknesses of an office workplace and their effect on performance and evaluation.

Wang *et al.* (2011) argued that the development of environmental auditing was an important move in response to global climate change, which they considered to be an environmental disaster as such change poses a huge danger to the health and wellbeing of humans, their environment, and global economics.

Today, many organisations place consideration on their ethical and responsible behaviour towards society, employees and other stakeholders as one of their top priorities (Goodall, 1995; Hafner & Shiffman, 2013). It has been observed that companies are normally less inclined towards being environmentally and socially responsible, which is why they are under pressure to do so these days (Goodall, 1995). If companies fail to behave responsibly, they may suffer by losing customer equity and employee loyalty - two key assets (Goodall, 1995; Ramaseshan *et al.,* 2013).

An environmental audit is a very effective measure for closely assessing each and every area of a business and the impacts of every sector of the company on the environment, including the magnitude of impacts. Therefore, this auditing tool is a good risk-controlling measure as it gives a company complete guidance on how to act in accordance with environmental laws and expectations. However, the successful implementation of an environmental audit is possible only when a benchmark level is set after a complete self-analysis of the firm's existing situation along with their commitment to undertake this process on a periodic basis by defining the goals of the organisation and bringing objectivity and transparency into the environmental auditing process (Cole & Rousseau, 1992). A study by Goodall (1995) found that action based on a wider application of environmental auditing will bring incremental improvements in the environmental performance of organisations.

Environmental auditing is a voluntary action for most firms. As a result, organisations that carry out environmental audits have to manage the tension between the incentives (e.g. ethics, individual commitment, accountability, legal, code of practice, anticipated regulation, to forestall regulation, marketing, public image, defence, to distract attention, influence perceptions) and disincentives of completing these audits (e.g. awareness of environmental issues and users not understanding the information). Between 1999 and 2009, 88,000 firms worldwide underwent environmental audits and this number increasing each year (Darnall *et al.,* 2009). The following sections discuss environmental auditing tools in greater detail.

2.2.1 International Standards

The International Organisation for Standardisation (ISO) is further developing the ISO 14000 series, a collection of voluntary standards that help firms achieve environmental and financial gains through the implementation of effective environmental management. ISO 14001 is the standard for environment management systems (EMS), which is a tool for environmental auditing. This standard was developed in response to the need for companies to balance environmental and social requirements. Many companies around the world have adopted environmental management systems (EMS) and many businesses have had their systems certified for ISO 14001 (Jiang & Bansal, 2003; Thakore *et al.,* 2014). ISO 14001 is an "international standard for environmental management systems (EMS) and an EMS is a set of management processes that requires firms to identify, measure and control their environmental impacts" (Bansal & Hunter, 2003: p.290). ISO 14001 is not a performance standard: it is a process-based standard that demonstrates that an organisation has implemented a management system that documents the company's pollution features and impacts, and classifies a pollution anticipation process. Bansal & Hunter (2003) argue that by improving the processes through developing a management system, ecological performance will ultimately develop.

Bansal & Hunter (2003) stated that ISO 14001 was flexible in order to meet the requirements of companies in different countries and industries. There are three principles that guide the standard and contribute to its flexibility: pollution anticipation, continuous development and voluntary involvement. Pollution anticipation reduces pollution before production begins. With continuous development, efforts are considered not as drastic changes but instead are incremental and involve ongoing adjustments to organisational measurement tools and controls. Finally, the voluntary nature of ISO 14001 facilitates buy-in from all types of companies without legal threat. There are six steps that must be followed in order to act in accordance with the ISO 14001 standard: develop an environmental policy; classify the company's activities, products and services that interrelate with the environment; identify legislative/regulatory necessities; identify the company's precedence with setting the objectives and targets for reducing their environmental impacts;

adjust the company's organisational structure to meet those objectives; and verify and correct the EMS (Bansal & Hunter, 2003).

As mentioned above, ISO 14001 is an international standard for EMS. This leads to the question of why ISO 14001 is the preferred EMS for so many companies around the world (Bansal & Hunter 2003). Jiang & Bansal (2003) state that an EMS is expected to persuade an organisation's environmental responsiveness because it creates suitable management structures. Despite the fact that EMSs vary considerably among companies, they do have some common fundamentals. An EMS requires a company to identify general ecological goals and targets and create or improve their environmental strategy. The company should identify its ecological impacts as well as determine the environmental regulations imposed, for example by management and local authorities. The company must also set up administration and operational control, monitoring and measurement actions and programs for its ecological impacts. In regards to why ISO 14001 is so often the preferred EMS, Bansal & Hunter (2003) found that while companies know how to put into practice an in-house EMS, an in-house EMS frequently lacks the legitimacy of ISO 14001, which can be easily documented by external stakeholders. Without ISO 14001, there is no audit procedure to ensure that the EMS accomplishes what it sets out to do.

2.2.2 Environmental Management Systems

The literature review reveals that environmental audits are great tools for improving environmental management systems and they provide an understanding of the fundamental relationships between human activities and the environment (Moldan *et al.,* 2012).

EMS has been defined as "formal systems and databases that integrate procedures and processes for the training of personnel, monitoring, summarising, and reporting of specialised environmental performance information to internal and external stakeholders of the firm" (Melnyk *et al.,* 2003: p.332). The main purpose for using an EMS is to build up, employ, control, organise and observe a company's environmental activities. This is done to accomplish two goals. The first goal is compliance, which means "reaching and maintaining the minimal legal and regulatory standards for

acceptable pollution levels for the purpose of avoiding sanctions" (Sayre, 1996: p.332). Compliance is beneficial for a company: for instance, a firm may have increased costs if they are fined for breaching environmental requirements. The second goal is waste reduction, which focuses on a company's behaviour on the dramatic reduction in its negative environmental impact (Sayre, 1996). As part of an EMS, Gonzalez-Benito (2006) stated that companies must develop environmental policies and goals with clear long-term environmental plans, knowledge of their environmental responsibilities, training programs, and performance measurement systems and evaluations.

To cause an organisation to institutionalise the concept of environmental auditing, the company has to first of all identify its current level of performance with respect to the environment. After forming a base or current performance level, the company needs to create a continuous assessing and auditing mechanism to review their performance in an environmental context. This will also help a company to re-evaluate its goals and objectives (Goodall, 1995).

Alrazi *et al.* (2010) suggested that an EMS can be evaluated based on the extent of its implementation. This entails having a list of scope within the EMS and, after developing the list, using it as a checklist in order to evaluate the current practices of the organisation. The literature suggests other techniques of assessing EMSs, including certifying the schemes, separating the environmental department from other departments (Alrazi *et al.,* 2010; Wahyuni *et al.,* 2009), and integrating ecological matters into a company's vision or mission statements (Elijido-Ten, 2007).

An EMS can be defined as a joint effort of inner exertions that are directed at analysing, evaluating, enforcing and the deriving of policies (Coglianese & Nash, 2001). Training the workforce regarding ecological topics, building up ecological execution indicators and objectives, enforcing contract-based environmental laws and internal ecological audits are all included as part of an EMS (Netherwood, 1998). Unlike management regulations that impose external requirements on firms, an EMS arises from within an organisation and consists of a voluntary self-regulatory structure (Coglianese & Nash, 2001).

An approach that is capable of understanding the different existing management schemes within a company is necessary when analysing such schemes (Coglianese & Nash, 2001). Due to its voluntary nature, companies can utilise this framework in different ways (Coglianese & Nash, 2001). For instance, some facilities link environmental performance to compensation (Netherwood, 1998), while others employ accounting methods that calculate presentation and ecological benchmarking (Nash & Ehrenfeld, 1997).

Organisations are greatly assisted by EMS as it allows them to examine their internal procedures, watch over their overall performance, augment their information regarding their functioning and connect the workforce to issues of the environment. The EMS structure also can help facilities prevent or reduce pollution by substituting unregulated for synchronised inputs and by eliminating some regulated processes altogether. As a result, facilities may no longer be subject to some costly regulatory mandates. This also results in a decrease of expenses because the facilities are now not obligated to pay the hefty amounts of regulatory mandates.

When guided by the ISO 14001 Standard, an EMS complies with the given (Plan, Do, Check & Act) framework. Every detail of the ISO Standard is covered by this framework. It is a five-step process:

1) *Policy*. The organisation's aims and objectives are defined and an environmental plan is drafted.
2) *Planning*. This step is the contriving and drafting process. It involves the verification of the pollution avoidance methods; constituting the programming, budgeting and development of the scheme; initialising aims and goals for enhanced work; pointing out authoritarian and other necessities; and identifying procedures, resources and major effects.
3) *Implementation*. This stage is the performance execution step, which involves implementing the drafting documents regarding the EMS (which includes document control and data maintenance); building and enforcing standard operating procedures; defining the constitution, tasks, and programs; initialising and executing emergency readiness and operating procedures; putting in action preparation; and instilling awareness amidst the workforce about EMS.

4) *Checking and Correction*. This step involves the preventative and corrective measure enforcement, glitch and source recognition, EMS reviews and analysing and evaluating the remedial measures (for example, internal analysis).
5) *Management Review*. This step involves the management review reassessing EMS, which also covers the internal performances of the organisation. In order to ensure it is fitting into place as required and for improved performance, the EMS is subjected to enhancements. The analysis of the administration is conceived in such a way that it naturally promotes improvement in the EMS, with regard to the outcomes of examination completed in (4) above.

2.2.3 ELAP Model

The ELAP model has been defined as the first model that identifies three conceptually distinct, but interrelated, concepts regarding corporate environmental behaviour from the literature (e.g. environmental legitimacy, environmental accountability, and environmental proactivity). It is the first model where it has been shown how they can be integrated into a single framework. Furthermore, it is defined as a framework that demonstrates an organisational journey towards achieving legitimacy in environmental endeavours.

The ELAP model has been used for this study as a foundation for the WEM framework. The ELAP model investigated three main components related to organisations: (1) corporate environmental behaviour, (2) environmental disclosures, and (3) environmental actions. These three concepts are environmental legitimacy, environmental accountability and environmental proactivity. This model was the first one to explain the relationship between environmental legitimacy, environmental accountability and environmental proactivity, yet the nature of these relationships was never tested.

The ELAP model, reproduced in Figure 2.1, examines three different concepts related to corporate environmental behaviour, environmental disclosures and actions. Furthermore, ELAP shows that legitimacy is one of the aims of a business in its ecological activities.

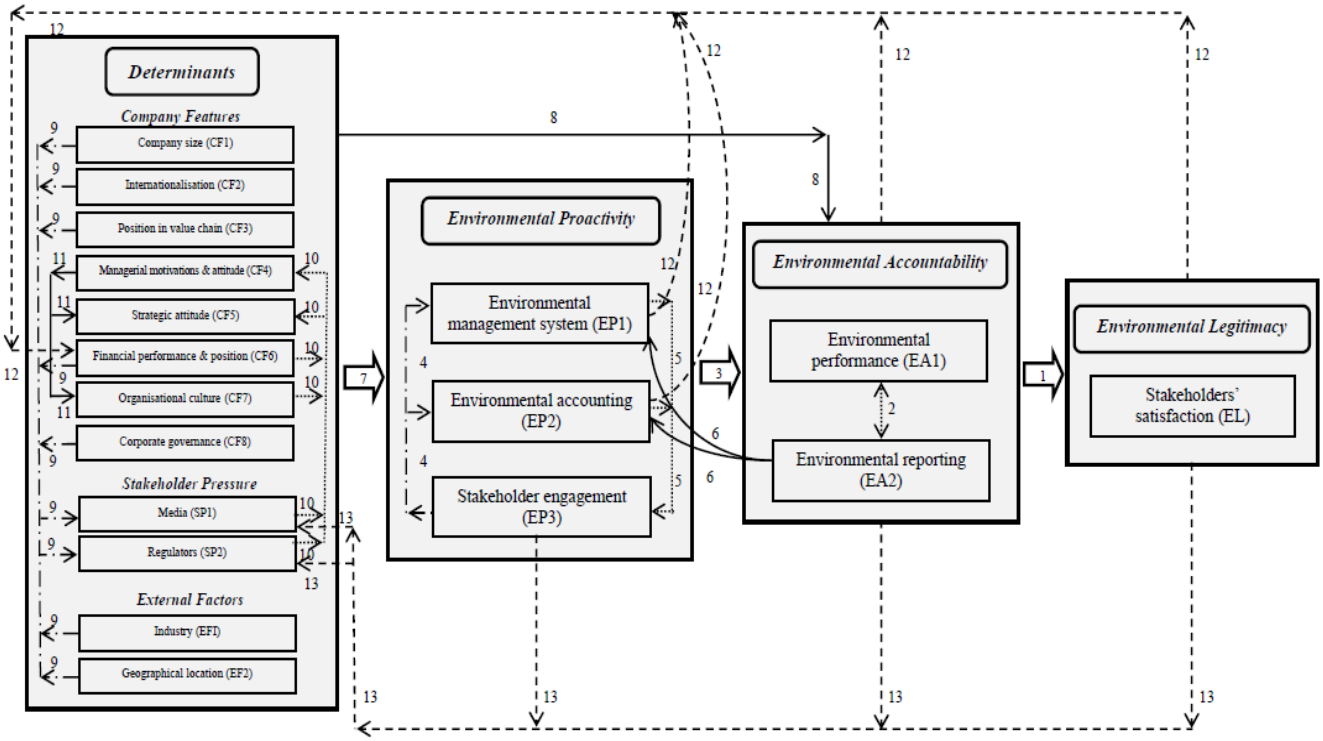

Figure 2. 1 ELAP Framework

Source: Arazi *et al.* (2010)

Alrazi *et al.* (2010) found that companies should ensure a sensible level of stakeholder satisfaction to hold their market share and that they place environmental legitimacy and stakeholder satisfaction in the same group. This involves paying attention to aspects of environmental accountability relating to two main concepts: environmental reporting and environmental performance. These are achieved through having a proper accounting system and environmental management and also increasing the environmental proactivity from stakeholder engagement. The ELAP framework also illustrated the characteristics that may affect legitimacy, accountability and proactivity. Indeed, the ELAP model provided a great base for researchers to build up a new expectation and relations that involve further investigation related to environment concepts.

Proactivity (Engagement)

Gonzalez-Benito (2006: p.88) defined environmental proactivity as improving ecological performance through the voluntary realisation of practices and initiatives. However, Alrazi *et al.* (2010) considered environmental proactivity as a process rather than an outcome. Global Environmental Management

Initiative (1998) considered environmental proactivity as a lead indicator, which is an in-process measure. Consequently, the methods of measuring environmental proactivity as process and environmental accountability as outcome are affected by the need of governments and organisations.

Gonzalez-Benito (2006) translated the concept of environmental proactivity into three main components of planning and organisational practices: the environmental management system, operational practices and communicational practices, or in other words the ecological impacts to the public. Alrazi *et al.* (2010) adapted Benito's conception, adding one additional component to these three, environmental accounting, and rephrased the third component to be stockholder engagement. He combined the first two features into a single component – EMS.

Van Staden & Hooks (2007) found that many studies have been written about what motivates companies to reveal information about their interactions with the environment. However, environmental proactivity is not a new term in the literature (Van Staden & Hooks, 2007; Rao *et al.,* 2009). A study by Doonan *et al.* (2005) found that improving the environmental performance of companies occurs due to external and internal pressures on companies and managers and that these pressures come from governments and the public, not financial and customer markets. Governments play a major role in pressuring companies to improve environmental performance and proactivity (Doonan *et al.,* 2005). It is imperative that companies continue to secure environmental practices to achieve their desired goal and to do so, they must be environmentally proactive (Rao *et al.,* 2009).

Kolk & Mauser (2002) indicate that environmental operational indicators and environmental management indicators symbolise environmental proactivity they place these two indicators as a part of environmental performance evaluation (see Figure 2.2).

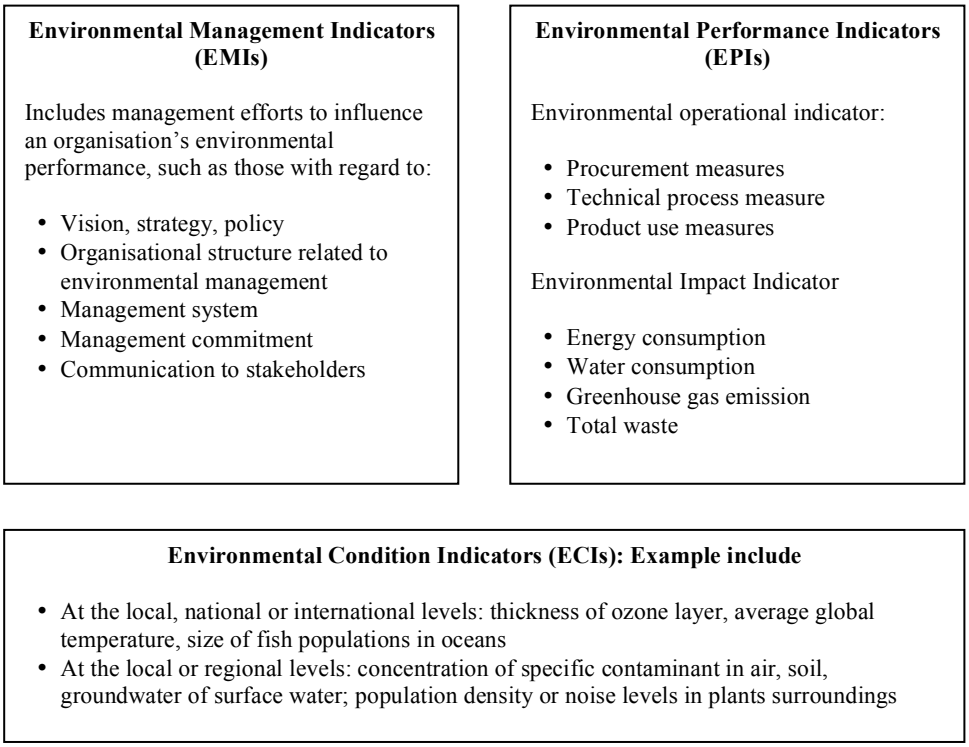

Figure 2. 2 Components for Environmental Performance Evaluation
Source: Kolk & Mauser (2002)

Ilinitch *et al.* (1998) found that measurement issues are becoming gradually more significant, resulting in increased attention paid to firms' environmental performance by government regulators, shareholders and the general public increasing. Related to proactivity, Ilinitch *et al.* (1998) found that aspects of performance, the managerial system and stakeholder relations are analogous to environmental proactivity.

Accountability

Accountability in management is an elusive concept because there is no effective way to measure the accountability of organisations has been clearly observed (Gray *et al.,* 1996). However, Gray *et al.* (1996) found that accountability leads to two sorts of responsibility: responsibility to report and responsibility to act. This means that firms should not only focus on environmental responsibility by maintaining the natural environment or minimising their negative impacts on the environment, they should also take into account efforts made to consider the community.

There are several definitions related to accountability in the literature. O'Riordan (1989) defined environmental accountability as the practice for social responsibility management. This practice came from two theories: public reporting and demonstrable responsiveness to the public interest. Burritt & Welch (1997: p.534) defined environmental accountability as "the actions made on behalf of organisations and the impacts of resulting activities on ecological systems". The Joint Committee on Public Accounts (JCPA) states that the aim behind environmental accountability is to provide "accurate and judicious measurement and reporting of performance" (Commonwealth of Australia, 1992: p.xii).

Al-Tuwaijri *et al.* (2004) undertook an integrated analysis of how management's overall strategy affects environmental performance, and found that firms should carry out business within the customs and anticipations of society, which is gradually demanding better environmental accountability. However, accountability means a heightened community study of both the companies' public disclosure of that performance and its environmental performance. These components of firms' environmental accountability mutually impact the value of the common equity of the company and its profitability (Al-Tuwaijri *et al.,* 2004). Shafer (2006) and Fukukawa *et al.* (2007) conducted questionnaire surveys in order to describe environmental accountability for the Corporate Accountability Commission and Canadian Democracy. Respondents were questioned regarding whether companies and their stakeholders must be held accountable on ecological issues and whether the government should accept standards for ecological accountability and force industries to adhere to their environmental duty in order to meet the standards of reporting.

In summary, environmental accountability involves two different concepts: environmental reporting and environmental performance. Hence, in this study, environmental accountability is the extent to which an entity acts sensibly towards the natural environment and reports on its ecological performance. On the other hand, accountability theory is focused more on stakeholder issues and, as a result of accountability theory, is not helpful in clearing up business behaviour (Deegan, 2006; Gray *et al.,* 1996).

Legitimacy as a Firm's Goal

Legitimacy has been defined as "a generalised perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions" (Suchman, 1995: p.574). However, according to Brønn & Vidaver-Cohen (2009), meeting social expectations is becoming gradually more essential for business to do in order to maintain their legitimacy in the public eye. The changing global business climate may now require companies to invest in social programs to maintain legitimacy within their organisational fields.

Brønn & Vidaver-Cohen (2009) state that social responsibility can be legitimatised through three main points: image building, altruism and profitability. They also found that the most important considerations related to the motive of legitimacy are to improve the company's image, being recognised for moral leadership, and serving the long-term interests of the company. The researchers also recognised that managers believe they are responding to these forces significantly by caring for the firm's image, creating goodwill among stakeholders and enhancing the legitimacy of the industry to which the company belongs.

Looking at the relationship between corporate image and legitimacy, Solomon & Lewis (2002) found that legitimacy theory is developed from the notion of a theoretical social contract between companies and society, hence one way in which firms can legitimise their actions and provide a good reason for their continued existence is by fulfilling their social ideals. Therefore, legitimacy theory gives an explanation of why firms may voluntarily disclose only the positive sides of their performance (Harte & Owen, 1992; Deegan & Rankin, 1996) and the researchers found the main reason for corporate environmental disclosure falls under improving corporate image.

According to Deegan (2002), legitimacy theory is a systems-oriented hypothesis similar to stakeholder theory. However, Deegan (2002) revealed that an organisation's survival will be in danger if society perceives that the firm has breached its social contract (see Gray *et al.,* 1996). However, Deegan (2002) notes that the public disclosure of social and environmental information in the media as part of an annual report in undertaking

legitimising principles such as motivation for reporting (to legitimise the organisation's operations) would be in contrast to a reporting approach, which reflects an approval by managers of an accountability or responsibility to reveal information to those who have a right to know.

Parker (2005) investigated social and environmental accounting. Grouping social and environmental accountability (SEA) helped to inform theoretical frameworks such as economics-based agency theory, decision-usefulness, stakeholder theory, accountability theory and legitimacy theory concerning social and environmental accounting. However, Parker (2005) found that legitimacy theory argues that an organisation is legitimised when its value system matches that of the social system of which it forms a part and that where there is a mismatch, the firm's legitimacy is threatened. Organisational strategies established to secure and maintain or bring back this match can consist of informing and educating its audience, trying to change their perceptions, deflecting their attention to other issues or trying to modify their expectations.

In regards to the same argument, Owen (2008) assembled a critical review of the existing developing and current social and environmental accounting (SEA) research. He argued that the political economy, legitimacy and stakeholder perspectives might best be viewed as alternative and mutually enriching rather than as competing theories. Owen (2008) also found that social and environmental accounting studies employed a legitimacy theory lens. Mobus (2005) studied employing legitimacy theory as an explanatory tool. He argued that the theory remains immature and using it to make specific predictions is hard.

Definition of Environmental Legitimacy

Many concepts concerning the environmental legitimacy of companies have been discussed in the literature. Bansal & Clelland (2004: p.94) stated that "environmental legitimacy is the generalised perception or assumption that a firm's corporate environmental performance is desirable, proper, or appropriate." They examined the media reports and stock prices of 100 firms over a five-year period and found that firms with low environmental legitimacy can alleviate this effect (the negative impacts of their low environmental

legitimacy) by expressing commitment to the natural environment. Bansal & Clelland (2004) maintained that environmentally legitimate firms have a less unsystematic stock market risk in comparison to illegitimate firms. Firms receive ecological legitimacy when their performance with respect to the natural environment conforms to the stakeholders' expectations and environmental legitimacy is realised when stakeholders are satisfied with the company's environmental procedures or performance.

In contrast, Neu *et al.* (1998) defined environmental legitimacy as something that is visible. For instance, the differing interests of financial stakeholders and environmentalists have been quite visible. The environmental disclosures of companies seek to manage the public impressions of organisational actions not necessarily through the provision of false information; rather, the disclosures can be selective in that they attempt to shape the way important members of the public feel or know about the corporation by highlighting specific organisational actions from within the domain of action that are positive, reformulating actions made visible by powerful external publics and ignoring actions made visible by less powerful external constituents (Neu *et al.*, 1998).

In regard to the definitions of environmental legitimacy definitions and the visibility of legitimacy, Hunter & Bansal (2007) identified the aspects of environmental communication present in environmental legitimacy by demonstrating that it is deep-seated in the reliability of the communication. They did this by measuring the credibility of the communication of 113 supplementary websites from 10 of the largest multinational corporations from heavily polluting industries. They found that environmental legitimacy is based on perceptions of the enterprises' environmental performance, not its actual performance. Since perceptions can be managed, Hunter & Bansal (2007) and Elsbach (1994) found that environmental legitimacy is not essentially associated with high environmental performance. Therefore, Hunter & Bansal (2007) argue that environmental legitimacy can be understood as a form of normative legitimacy approved by society and that it is not easy for multinational firms to gain environmental legitimacy. Furthermore, environmental practices are not easily visible. In relation to

stakeholder issues, the authors found that companies always communicate with stakeholders to present a desirable image in order to increase legitimacy.

A number of recent studies of legitimacy appear increasingly divided into two different groups that always operate at cross-purposes: the strategic and the institutional (Webb *et al.,* 2009). Nonetheless, "legitimacy is a generalised perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions" (Suchman, 1995: p.574). Firms look for legitimacy for many causes and draw conclusions about the consequence, difficulty, and efficiency of legitimation. These efforts may depend on the objectives next to which these efforts are measured. Suchman (1995) discussed three types of legitimacy: pragmatic, moral and cognitive. The author found that all three types have a strong relationship to the definition of legitimacy. Furthermore, firms that show legitimacy are likely to be around for longer or have long-term success, since audiences are most expected to supply resources to firms that appear desirable, proper or appropriate. Also, legitimacy affects not only how people act toward firms but how they understand them. Consequently, audiences regard an organisation they perceive as legitimate not only as more praiseworthy, but also as more trustworthy, predictable and important (Parsons, 1960; Suchman, 1995).

In summary, legitimacy and disclosure are useful in providing information about a firm's performance to their stakeholders or audience as well as informing the relevant public and modifying public expectation about its performance. Legitimacy is a concept that can be used to increase insight into the motivation a corporation has for providing industry social disclosure on a charitable foundation and into the nature of disclosure use by the public (Lindblom, 1994).

Measuring Environmental Legitimacy

Bansal & Hunter (2003) measured environmental legitimacy by using the Janis-Fadner coefficient for content analysis of imbalance. The rate ranged from -1.0 to +1.0, with a value of +1 showing a high presence of favourable articles while, -1.0 designates a high occurrence of adverse articles. The researchers also provided some explanation about ISO and legitimacy and

found that companies that specialised early for ISO 14001 had well-built international presence, a considerable environmental legitimacy and the drive to recover their corporate image by conferring greater environmental legitimacy (Jiang & Bansal, 2003). Furthermore, it was found that the elasticity of ISO 14001 allows companies to convene the environmental performance legitimacy requirements of the different jurisdictions in which it works and lead to improved relations between government and stakeholders and reduce the amount of the fines and penalties on the company. Thus, companies that have low environmental legitimacy could use the opportunity to exercise ISO 14001 in order to signal to stakeholders a new obligation to the environment (Bansal & Hunter, 2003).

The discharge of new environmental information has a continuing impact on companies. Bansal & Clelland (2004) offered insights about the stakeholders, such as customers, competitors and regulators, who can influence investors' assessments of corporate environmental legitimacy. Bansal & Clelland (2004) note that the articles from the media have been used in previous research to assess investors' responses, however, after they reviewed the formula used by Bansal & Hunter (2003), they were concerned with the Janis-Fadner coefficient of imbalance.

Clarkson *et al.* (2008) used the same formula for measuring legitimacy as (Bansal & Hunter, 2003; Bansal & Clelland, 2004). According to Clarkson *et al.* (2008), there is negative association between legitimacy and the level of disclosures implied by socio-political theories and that socio-political theories are not robust in predicting the level of discretionary environmental disclosures.

Under the same topic of measuring environmental legitimacy, Aerts & Cormier (2009) used public media data to review generalised perceptions of a company's environmental legitimacy. They also measured legitimacy by using the Janis-Fadner coefficient of imbalance. They found that environmental press releases and annual report environmental disclosures work as legitimation tools and that negative media legitimacy has a key role in environmental press releases other than annual report environmental disclosures. Aerts & Cormier (2009) revealed that environmental legitimacy is considerably and surely affected by the quality of annual report environmental

disclosures and also by reactive environmental press releases, noting that companies use annual report disclosures and press releases as communication media to prove to the relevant public that their behaviour is appropriate and desirable and, at the same time, to react to public concern regarding the content and quality of their environmental information dissemination processes. Aerts & Cormier (2009) considered that the connection between environmental performance and environmental disclosure is a strong indicator of the legitimising nature of the information types and that the communication strategy used by companies affects their environmental legitimacy.

The most common way used in the literature to measure environmental legitimacy is by examining the media (e.g. Aerts & Cormier, 2009; Bansal & Clelland, 2004; Bansal & Hunter, 2003; Clarkson *et al.,* 2008). Most researchers have used the Janis-Fadner coefficient of imbalance; however, they have also indicated that there are numerous problems that can make the measure insufficient. The main problem was that each researcher used a different database source. For example, Clarkson *et al.* (2008) used the Factiva database, Aerts & Cormier (2009) used the ABI/Inform Global database and Bansal & Clelland (2004) used the Wall Street Journal. As a result, dissimilar levels of credibility and reliability may be found because different media sources and press releases are incorporated through media coverage, therefore indicating that the company documents do not reflect stakeholder satisfaction.

Furthermore, in relation to media and disclosure, Gago & Antolin (2004) found that decisions made by firms could affect stakeholder results for investments. They also noted that there is a strong relationship between companies and the media, which in turn affects the decisions of investors and the reputation of the company. However, the media was graded as among the stakeholder clusters with the least 'legitimate' demand.

Neu *et al.* (1998) examined why environmental disclosures are observed in annual reports, who is the intended audience of these disclosures and what are the intended effects of these disclosures. The researchers assumed that the amount of space devoted to the firm's environmental activities provides a measure of the emphasis placed by the organisation's managers on environmental disclosures. However, items of information included in

voluntary environmental disclosures are not necessarily a representative measure of actual environmental performance and may in fact misrepresent a firm's performance in comparison to other firms in the same industry. Nevertheless, they found that the amount of media coverage given to environmental fines during a particular year was correlated with increased levels of environmental disclosure. They also found that environmental criticism of companies by the media resulted in lower environmental disclosure, thus raising a question about the use of media coverage as a valid measure of environmental legitimacy or stakeholder satisfaction.

There were also some studies that used different tools to measure the legitimacy of the environment. For example, a study by Bortree (2011) used a questionnaire to measure legitimacy. He conducted an online survey comprising 289 undergraduate students to measure their awareness of the environmental aspect of a firm's television advertisement for new goods. The students were acting as the potential customers or general public and rating the campaign's environmental reporting. The finding was that raising awareness of an organisation's environmental initiative improves environmental legitimacy. The weakness in this study is that Bortree (2011) used a particular group of stakeholders and this may affect the results obtained. In such studies, researchers should expand the area of the sample or the expansion of the scope of stakeholders that will lead to more accurate results.

In summary, the ELAP model forms an important foundation for the further development of environmental auditing from general business performance to the context of physical workspaces using a unique approach to explore the latent relationships involved. Hence the next section looks at the application of ELAP to buildings in more detail.

2.2.4 Application to Buildings

In recent years, the decision to adopt an environmental management system and to develop effective implementation strategies has engrossed managers at all levels and in all type of organisations. However, few studies have explored the implementation process for environmental auditing.

Studies by Dowie *et al.* (1998) and Chan & Hawkins (2012) on how buildings implement environmental management systems as a tool for environmental auditing found that solid waste EMSs were successful in significantly reducing levels of waste, primarily due to the level of involvement of all stakeholders during the initial waste audit process. The researchers found that an EMS can achieve momentous success with limited resources of workers and finance.

Chan & Li (2001) ran a study looking at the EMS of different firms and found that more than half of the small to medium organisations surveyed had not before heard of ISO 14001. They concluded that organisation type was an important consideration in terms of EMS adoption. Organisations that have an environmental impact should invest more financial and human resources to control their environmental outcomes. A study by Pun *et al.* (2001) found that there is a seven-step approach to implementing an EMS that could help to control the environmental outcomes of buildings. This comprised self-assessment, department policy, organisation, planning and implementation, performance assessment, regular reviews, and continual improvement.

Chan & Hawkins (2012) found that the adoption of an EMS for educational buildings could help build organisational structure, internal environmental guidelines, external environmental regulations, environmental auditing, environmental goals, environmental programs, environmental reports, environmental information systems, environmental training courses, and staff involvement/public relations.

Another study by Galan *et al.* (2007) evaluated the environmental practices of agricultural farms as a first step in the implementation of an EMS, including monitoring farm management practices. The results of the research study showed that there was strong variation among environmental management tools in terms of their evaluation of environmental impact, which strongly influences their validity in an agricultural environment.

Curkovic & Sroufe (2011) may have been the first to examine ISO 14001 and its implication in buildings. They found that there are six concepts for pursuing ISO registration: competition, customers, image/reputation, risk mitigation, resource conservation, and cost reduction, and developed several research propositions. These six concepts help companies to achieve their

goals. Case-based research was used in this study to address the competing views of the standard to show that ISO 14001 registration can be leveraged across the supply chain into competitive advantage.

Environmental auditing and its applications to FM need more effort than has occurred to date. This research explores environmental auditing of office buildings and broadens the scope of the environmental audit by using workplace as the focus of the procedure. The next section investigates the laws and regulations concerning the application of environmental audits on buildings.

2.2.5 Compliance and Legal Requirements

In the last century, significant change has occurred around the world related to the environment (Tilt, 2001). A study by Tilt (2001) found that increasing attention on environmental auditing is occurring due to three reasons: a growing number of firms conducting environmental audits, that most audits include a review of the EMS in place; and a growing number of audits focus on sustainability (Simnett *et al.,* 2009). Nevertheless, in many developing countries audits have barely evolved beyond the level of legal compliance.

Environmental auditing is not a legal requirement, so if organisations adopt environmental auditing processes voluntarily they might earn increased credit and trust (Cole & Rousseau, 1992; Sands & Peel, 2012). However, environmental auditing does involve ensuring that companies are fully compliant with the relevant environmental legislation. Therefore, the audits' objectives and processes are often based on government requirements (Rika, 2009). Like other management tools, environmental auditing is a very broad process that involves aspects of systemisation, objectivity, documentation and continuous measures that are levied on the organisation. The purposes of environmental auditing are to help management build a strong organisation by producing favourable impacts on the environment and to help organisations to abide by environmental rules and regulations (Cole & Rousseau, 1992). This concept applies not only to the organisations that impact the environment but also to their physical assets.

In an environmental audit report, all information pertaining to a company's environmental performance get elicited and presented to management. Factors

like environmental impact, core problematic areas, adherence to rules and regulations, deficiencies and many other aspects are highlighted in such reports (Goodall, 1995). The construction and operation of buildings involves the audit of energy from the environment to a considerable extent, so environmental auditing comes into play in the area of operational energy (Cole & Rousseau, 1992). Therefore, in regard to built facilities, it is important to have a complete and comprehensive understanding about the operational performance and its related factors, using a number of different tools (Cole & Rousseau, 1992).

A study by Rika (2009) identified the enactment of relevant legislation as a most important contributing factor to the global increase of environmental auditing. Many countries have passed laws that require entities to make social and environmental disclosures. For instance, the US National Environmental Policy Act of 1970 and subsidiary legislation necessitate businesses to take responsibility for the impact on the activity of air, water and land.

In Australia, governments have established agencies to put into effect environmental protection to manage air, water and land contamination (Rika, 2009). For instance, environmental management and accountability of organisations has become an important focus of government and firm policy during the last 25 years in western countries such as Australia and New Zealand has led them introduce new laws relating to environment practice (Chiang & Lightbody, 2004). For instance, in 1991 New Zealand introduced the Resource Management Act. This act was perceived to have improved both the demand for environmental audits and the widening of their scope. However, environmental legislation is needed; it may fail to enhance accountability, mainly if firms focus on avoiding government penalties instead of improving processes. As noted by Chiang & Lightbody (2004), there is a hazard that legal requirements will be regarded as an acceptable standard instead of a minimum standard.

2.3 Sustainability and Green Buildings

2.3.1 Sustainable Development

With the passing of time, there has been increased development in built facilities, some of it pertaining to the needs of a growing population and some

pertaining to new technology and processes. Population growth has resulted in the construction of cities with high-rise buildings and as well as urban areas that were once largely unoccupied. Such expansion has raised concerns worldwide with regards to environmental hazards. Many consumers now demand that the products they purchase are environmentally-friendly and not upsetting the natural balance. Businesses now are more focused on the services that they provide to their clients. Many people are of the opinion that the development of environmentally-friendly products is still at a very small scale and there is a lot of potential of growth and exploration to follow (Quental *et al.,* 2011; Kates *et al.,* 2005). The practice of sustainable development and growth is still in preliminary stages and more awareness and research needs to be done to bring it into mainstream practice.

From among the many definitions of sustainability that exist, the most common and generally used definition is the one that takes into consideration the natural environmental (as opposed to sustainable economic growth, for example). It says that when the companies are operating in an environment they have to give back to it in a positive manner and at the same time be mindful of the impact their operations might have on natural resources. The other factor that has to be considered when defining sustainability is the impact operations might have on people and society in general (Delgado-Ceballos, 2014).

There are many organisations now that have started taking notice of their impact on the environment. This growing consideration has resulted in better environmental awareness throughout modern society, particularly in developed countries. Now built environment stakeholders are also taking into consideration the impact of their buildings both during the design and construction process, and ongoing occupancy. A study conducted by Manchanda & Steemers (2009) stated that there is no connection between the satisfaction of users and the amount of energy that they are consuming. Organisations are now adopting low energy consumption methods to reduce energy demand and contribute back to the environment in a 'greener' way.

It was found that people who have awareness about green buildings are the ones that can make the most of it. People who are not aware or have not experienced what they can gain from working in such spaces tend to consider

sustainability as an overrated concept. Sustainability means creating and developing a system (or 'ecosystem') that helps the environment in the long run (Kato & Murugan, 2010).

Today many organisations are looking to develop a greener work environment for their employees. Current workplace ethics call for the employees to be environmentally aware (i.e. reduce, recycle, reuse) as well as clearly identify opportunities for corporate social responsibility (Govindan *et al.,* 2013). The concept of social corporate responsibility is evolving and being practised fashionably worldwide in organisations that are looking to attain competitive advantage. Organisations today are also training their staff to understand and apply the concepts of sustainable development (Dao *et al.,* 2011).

2.3.2 Green Building Rating Tools

Intense development, technological competition and globalisation have led to spectacular change in building technology. The emergence of green building assessment tools have progressed the development of guidelines and certification processes (Fauzi *et al.,* 2013). However, green building is mainly confined to energy efficient usage, water conservation, the use of recyclable materials, non-toxic products and other features that contribute to a small ecological footprint (Ali & Al Nsairat, 2009).

Tools like the Building Research Establishment Environment Assessment Method (BREEAM) and Leadership in Energy and Environmental Design (LEED) first appeared in 1990 and 1998 respectively. BREEAM and LEED models have become the blueprints of reference for building sustainability (Fauzi *et al.,* 2013). These tools have continued to evolve and change, and have birthed similar tools in countries outside the UK and US. This section provides of green building rating tools that have been used in recent years.

In the late Twentieth Century, awareness increased about the impact of technology and population growth on natural resources. Nations started to focus their efforts to decrease their ecological impact and buildings have been recognised as major contributors to the world's energy usage, landfill waste and diminishing green space (IFMA Foundation, 2010). Building rating schemes have emerged as a means of guiding the design and operation of more environmentally-friendly buildings. This section summarises the most

popular green rating systems used in practice: namely BREEAM, LEED, Green Globes and Green Star.

The BREEAM system is perceived as being elastic but strict in areas where local regulations are not valid. BREEAM is one of the major certification systems in the world and there is a requirement for the assessor to be involved in all stages of the process (Julien, 2009). LEED, on the other hand, is a rating system developed by the US Green Building Council (USGBC), with a focus on the design and construction of buildings. Green Globes and Green Star represent further acceptance of the need for rating tools to assess environmental performance. Table 2.1 shows the various categories used in each of these rating tools (IFMA Foundation, 2010).

Table 2. 1 Most Widely Used Green Rating Systems

System	Year established	Country of origination	Buildings certified	Rating schemes	Certification levels	Categories
BREEAM	1990	United Kingdom	Over 110,000	Communities Courts Education Health care Homes Industrial International Multiresidential Offices Prisons Retail Other	Pass Good Very Good Excellent Outstanding	Energy Health & well-being Land use & ecology Management Materials & water Pollution Transport Water
LEED	1998	United States	Over 7,400	Commercial interiors Core & shell Existing buildings Health care Homes Neighborhood development New construction Retail Schools	Certified Silver Gold Platinum	Awareness & education Energy & atmosphere Indoor environmental quality Innovation in design Locations & linkages Materials & resources Regional priority Sustainable sites Water efficiency
Green Globes	2000	Canada	Over 1,400	Existing buildings New construction	1 Globe 2 Globes 3 Globes 4 Globes	Effluents & other impacts Emissions Energy Indoor environment Project management Resources Site Water
Green Star	2002	Australia	Over 220	Education Health care Industrial Multiresidential Office as built Office design Office interiors Retail center	4 Star 5 Star 6 Star	Emissions Energy Indoor environmental quality Innovation Land use & ecology Management Materials Transport Water

IFMA Foundation (2010) recognised that there are other systems not so well known but which are actively used in various parts of the world. These are listed in Table 2.2.

Table 2. 2 Other Rating Systems

System	Year established	Country of origination	Buildings certified	Rating schemes	Certification levels	Categories
BEAM	1996	Hong Kong	199	Existing buildings New buildings	Bronze Silver Gold Platinum	Energy use Indoor environmental quality Material aspects Site aspects Water use
EEWH	1999	Taiwan	Over 200	New construction	Certified Bronze Silver Gold Diamond	Biodiversity Carbon dioxide emissions reduction Conservation Energy conservation Green landscaping Indoor environment Sewage & garbage treatment Site water Waste reduction Water resource
GBCS	2002	South Korea	Over 120	Hotels Multiuse Multiuse dwellings Office buildings Residential Schools Stores	Best Excellent	Energy efficiency & load on the environment Indoor environmental quality Land use & transportation Site ecology
CASBEE	2004	Japan	80	Existing building Heat island Home New construction Renovation Urban area & buildings Urban development	S (excellent) A B+ B- C (poor)	Energy efficiency Indoor environment Local environment Resource efficiency
Green Mark	2005	Singapore	300	District Existing buildings Infrastructure Landed houses Nonresidential new buildings Office interiors Residential new buildings	Certified Gold Gold plus Platinum	Energy efficiency Environmental protection Indoor environmental quality Other green features & innovation Water efficiency
SI-5281	2005	Israel	1	New construction	Green building Outstanding green building	Energy General assessment Land Water Wastewater & drainage Other environmental subjects
LiderA	2005	Portugal	9	Buildings	C level B level A level A+ level A++ level A+++ level	Efficiency Environmental comfort Environmental management & innovation Load impacts Resources consumption Site & integration Socioeconomic adaptability
HQE	2005	France	Over 340	NC lodging NF Tertiary buildings NF MI – Detached homes	Basic performance High performance Very high performance	Comfort Eco-construction Eco-management Health
3-Star	2006	China	15	Commercial Residential	1 Star 2 Star 3 Star	Energy savings Land savings & outdoor environment Material savings Indoor environmental quality Operations & management Preference items Water savings
GRIHA	2006	India	1	Education Health care Multiunit residential Office as built Office design Office interiors Retail center	1 Star 2 Stars 3 Stars 4 Stars 5 Stars	Building operation & maintenance Conservation & efficient utilization of resources Energy Health & well-being Waste management Water
DGNB	2008	Germany	78	New building - office	Bronze Silver Gold	Ecology Economy Location Processes Social-cultural & functional Techniques

Buildings contribute significantly to climate change as they emit considerable amounts of CO_2 (Reed *et al.*, 2009). Furthermore, green buildings generate benefits such as market value, health, workplace productivity, image, and

resource conservation (Crespi *et al.,* 2004). It is difficult for the stakeholders to measure the level of sustainability in a construction project (Al Waer *et al.,* 2008; Reed *et al.,* 2009), but green rating systems help them to compare the sustainability of buildings by using common terms and units of reference - an 'international language' of sorts (Reed *et al.,* 2009). In order to develop knowledge about sustainability and create a more ecologically-friendly building industry, many countries have now introduced rating systems for buildings (Reed *et al.,* 2009).

A study by Reed *et al.* (2009) that undertook a broad comparison of three systems found that Green Star's rating system corresponds closely to LEED and BREEAM, and all of these systems provide the tools for a broad-ranging assessment of the ecological impact of a building. However, the units used by the rating systems are different. Green Star uses a star rating from 1 to 6; LEED rates according to a scale of platinum, gold, silver, and bronze; while BREEAM adopts a range from 'pass' to 'outstanding'. This study reviews all three and demonstrates why they create a common language, set a standard of measurement for green buildings, promote integrated whole-building design, recognise environmental leadership, identify building lifecycle impacts, and raise awareness of green building benefits.

It is worth mentioning here the emergence of new concepts related to green building such as Green Building Challenge (GBC), defined as unique international research, development and dissemination efforts to further the understanding of building environmental performance assessment tools (Kohler,1999). However, the GBC has been in an exclusive position to test and adopt new thoughts and implement step changes. GBC's roles over the past five years have been to provide a reference framework, method and tools that can help to develop new systems or advance existing systems, provide a forum for discussion among researchers and practitioners worldwide, and raise awareness and credibility of assessment systems (Todd *et al.*, 2001).

2.3.2.1 BRE Environmental Assessment Method (BREEAM)

The dominant assessment method for green building is BREEAM, which is defined as an assessment that uses recognised measures of performance, set against established benchmarks to evaluate a building's specification, design,

construction and use" (BREEAM, 2011). BREEAM was developed by the Building Research Establishment (UK), in 1990, in order to measure the sustainability of new non-domestic buildings.

BREEAM has eight different categories. Some other countries, for example Canada and the Netherlands, have developed them own BREEAM. BREEAM Europe and BREEAM Gulf are also available to use under the umbrella of BREEAM International. However, it is required that a BREEAM international assessor be used to review the buildings when the international scheme is used (IFMA Foundation, 2010).

There are two steps required to achieve BREEAM certification. Firstly, an assessment of construction must be completed by a BREEAM pre-assessment estimator to determine the nature of the building scheme. Secondly, the goals for the project must be stated and approved, including certification level, enhanced processes, and the addition of optional power sources. In addition to just gaining approval for certification, there are several levels for BREEAM certification, each with different compliance levels as follows:

- *Pass*: involving a rating of 30%
- *Good*: involving a rating of 45%
- *Very good*: involving a rating of 55%
- *Excellent*: involving a rating of 70%
- *Outstanding*: involving a rating of 85%

Previous research has suggested that green buildings can provide improved comfort, productivity, and health by ensuring that individuals receive more natural light as well as better air quality (Kats, 2003; Paul & Taylor, 2008; Ries *et al.,* 2006).

2.3.2.2 Leadership in Energy and Environmental Design (LEED)

Consumption culture, innovative technologies, new rules and policies by governments and market change have nurtured the integration of different innovative approaches dedicated to design of buildings that are safer for the environment (Spiegel & Meadows, 1999; Crespi *et al.,* 2004). LEED is one of the initiatives that is making the building industry more environmentally-responsible (Dean, 2003; Elizabeth & Adams, 2000; Yudelson, 2004).

LEED has been defined "as one of the most recognised systems that provide a complete framework for assessing building performance and meeting sustainability goals" (Crespi *et al.,* 2004: p.2). It was founded and designed by USGBC in 1998, and is defined by its creators as a national, consensus-based, market-driven building rating system designed to accelerate the development and implementation of green building practices (USGBC, 2011). LEED encompasses several rating systems such as commercial interiors, core and shell, new and existing buildings, health care, homes, neighbourhood development, retail and schools.

Additionally, LEED seeks to improve the performance of buildings through measurements such as power savings, water efficiency, CO_2 emission reduction, enhanced indoor environmental value, and stewardship of resources and sensitivity to their impacts (IFMA Foundation, 2010). Additionally, a study by Crespi *et al.* (2004) found that LEED is looking to develop high-performance sustainable buildings that establish a common standard, promote integrated design practices, recognise eco-leadership in the building industry, stimulate competition, raise consumer awareness of green building benefits, and transforming the building market.

The USGBC provides checklists for each rating system with the intention of outlining the prerequisites and credits for various actions. While the checklists can be used to recognise the opportunity of earning each credit as a 'yes', 'no' or 'maybe', they are supposed to be used before the commencement of the design/construction process in order to decide which credits are feasible for the building and what level of certification is required. The certification levels for LEED which are explained as follows (Crespi *et al.,* 2004):

- *Certified*: a score of between 26-32 points
- *Silver*: a score of between 33-38 points
- *Gold*: a score of between 39-51 points
- *Platinum*: a score of between 52-69 points

The cost of LEED certification is different for members and non-members (Crespi *et al.,* 2004). LEED is considered to address complete building ecological performance, with an abundance of credits in every impact area (Crespi *et al.,* 2004). Scheuer & Koeleian (2002) found that the absence of

consistent standards of classification of buildings would affect both individual building performance and the achievement of broader ecological policies. On the contrary, as shown earlier in Table 2.1, BREEAM has certified over 110,000 buildings, LEED have been certified over 7,400, while Green star have certified over 220.

2.3.2.3 Green Star

Australia is a leading country in the development and implementation of sustainable practices in the building industry. Building evaluation schemes have emerged as a means of guiding the design and process of more environmentally-friendly buildings. The sustainability of buildings in Australia is measured using the Green Star rating system. The number of green buildings in Australia has increased significantly since the Green Building Council of Australia (GBCA) launched in 2002 (Armitage *et al.,* 2011).

GBCA has described Green Star as a comprehensive, national, voluntary environmental rating system that evaluates the environmental design and construction of buildings. The Green Star system is used for new buildings or renewals in design or construction (refurbishment). Obtaining Green Star certification in Australia requires developers to register the relevant building with the GBCA. After registration, the GBCA confirms the eligibility of the construction and assigns a case manager to assist the consultant team throughout the process.

Kato & Murugan (2010) conducted a study on the experiences of working, renting and owning Green Star certified buildings. This study had a number of recommendations for real estate development companies, investors and end users that will help improve the performance of green buildings in Australia. Their recommendations were: (1) improve education, (2) develop an effective green strategy, and (3) make good use of sustainability experts. Kato and Murugan (2010) found that people who have experience in working or living in green buildings obtained the greatest benefit in terms of sustainability when compared to people without that experience and this is consistent with what has been found elsewhere in the literature (Kato & Murugan, 2010).

It is currently not possible to employ Green Star outside of Australia, with two exceptions (IFMA Foundation, 2010). The system has been adopted as Green

Star South Africa and Green Star New Zealand and adapted to fit the requirements and regulations of those countries.

There are nine categories evaluated through Green Star comprise management, indoor environment quality, energy, transport, water, materials, land use and ecology, emissions, and innovation. Three certifications are available: 4 stars (45-59 points) signifying 'Best Practice' in environmentally sustainable design and/or construction, 5 stars (60-74 points) signifying 'Australian Excellence', and 6 stars (75-100 points) signifying 'World Leadership'.

2.3.3 Measuring Environmental Performance

Since the 1960's, experts and analysts started showing concern for the changing ecosystem conditions, but quantifying the impact of actions on the environment has long been a problem. Initially the major hurdle was the lack of information about the pollutants and other toxins involved in operations. In order to reach conclusive and authentic results, a set of guidelines and definitions of key parameters and variables were necessary that would help in measuring the impact on the environment, and hence assist in making decisions.

Wood & Jones (1995) acknowledged 16 empirical management studies issued from 1972 to 1993 along with several deduced values of firms' environmental performance. Wood & Jones (1995) suggested that there is a requirement of measuring real environmental performance for both real and virtual terms in order to improve the flow of research. Around the 1970s the Council on Economic Priorities published corporate reports of specific pollution rankings of industrial organisations to highlight their annual performance.

In a study that was conducted by Logsdon (1983), the problems faced by the companies that are capturing the real data on their own performance are illustrated. It also showed how the petroleum companies handled the crisis related to pollution that their products were causing. The research was based on the data collected through direct research and by going through previous records. The main focus was on the environment-related issues. He looked at 10 organisations. The small amount of companies that were considered clearly shows that getting reliable information was not easy. The huge amount of effort required made this task a very difficult one.

There are four databases that are available to the general public containing detailed news and information about the environmental compliance of the US firms. The four databases are:

- US Environmental Protection Agency's toxics release inventory (TRI);
- The Kinder, Lydenberg, Domini (KLD) Socrates database;
- The Council On Economic Priorities (CEP) Corporate Responsibility Reporter database; and
- The Investor Responsibility Research Center (IRRC) database.

Companies that have higher and efficient environmental practices are the ones that have sacrificed more to adopt new practices. Companies have employed many indicators that will help them identify the result of their current practices. Compliance with given standards is now a new norm in the corporate world (Delmas & Blass, 2010; Chen & Delmas, 2011).

2.3.4 User Controls

User control generally means the authority one can have over controlling his/her surrounding environment using thermostats, fans, windows, blinds, etc. The general consensus is that building users feel more comfortable when they have active control over their surroundings (Fountain *et al.,* 1996; Karjalainen & Koistinen, 2007). It is agreed that no thermal environment can satisfy everyone equally. Clements-Croome (2000) argued that efficiency is proportional to the performance the internal environment. For general wellbeing, control over thermal conditions in particular is necessary. Control over environmental conditions in office buildings can improve work efficiency as less people suffer from ailments caused by sick building syndrome (SBS) and absenteeism drops (Leaman & Bordass, 1999; Karjalainen & Koistinen, 2007). Due to these reasons, modern offices have implemented more controls for users and zoning strategies with sensors. Modern technology has improved the ease of use of control devices including computer monitoring, automation, and data recording.

Furthermore, Foster & Oreszczyn (2001) investigated window blind user control by conducting a survey in four offices located in Tokyo, where they sent questionnaires to the occupants. Firstly it was found that most office

workers wanted a seat near the window. They also found that approximately 60 per cent of adjustable blinds did not move all day long.

2.3.5 Design Feedback

It is imperative that the designers have knowledge of the demands, needs, hopes and desires of the users prior to designing any new product. The best designs can be proposed only if an understanding of the needs of future users has been provided. The knowledge obtained from carrying out such research has considerable impact on the workability and usefulness of any proposed design (Bruseberg & McDonagh-Philp, 2002).

The information regarding the desires and needs of users with respect to any product must be provided to the designer as early as possible so that they have enough time to analyse it and respond. Using this information the designer can extract questions and further process the information to obtain refined and specific data. Focus group activities allow the designers to carry out the design process using multiple techniques instead of focusing on a single strategy. This encourages better understanding of the needs of the users and facilitates the further development and improvement of the design (Burns & Evans, 2000), and ultimately results in products that are more in accordance with the needs of end users (Jordan, 2000).

User-centred design is dependent upon the amount of freedom of choice given to the users and the degree of freedom of expression and decision-making awarded. Carmel *et al.* (1993), proposed three different levels of coordination that can occur between consumers and producers:

1) *Consultative design* – the users are considered as the key contributors to the design of the product
2) *Representative design* – a group of users are selected and the design of the product is based on their preferences
3) *Consensus design* – total autonomy is given to the users and the design is then formulated

Research carried out by Leonard & Rayport (1997) claimed that traditionally the procedures that are used to conduct market research are all segment-based as only a small population of the consumers get to represent their

preferences. The design that is truly acceptable by the consumers should be based on the preferences of all the consumers rather than a select group of consumers. The best way of observing consumers is in their natural habitat. This kind of research can be very hectic and time-intensive, but the results produced are more reliable. Conducting focus groups is also a popular method of research to identify user preferences. Focus groups along with observation helps create a product that more likely deals with the requirements of users.

2.4 Occupant Comfort and Wellbeing

This research explores how employee performance is affected by workplace ecology, which is evaluated by particularly understanding post-occupancy issues and situations. The research explores how the surrounding environment in the workplace affects the worker's performance and output. The related theories and concepts with regard to POE are liberally referred to in the course of this thesis in attempting to understand the factors affecting the worker, and how the same could be improved upon in the quest for greater productivity.

2.4.1 Thermal Performance

In the course of the past few years, architects and planners have paid more attention and consideration to the design and layout of buildings to ensure that energy and environmental concerns are adequately addressed. This could be attributed to the increasing awareness of sustainable design concepts, and how these in turn are affecting the wellbeing of individuals (Steemers & Manchanda, 2010).

Lan *et al.* (2010) explore how surroundings affect the individual in varying degrees, reflected in physiological and psychological manifestations. Indeed, the human mind is perhaps far more sensitive to the surrounding stimuli provided, and is more attuned towards reacting to the events and circumstances surrounding the individual when compared to the physical reactions exhibited (Parsons, 2000). However, considering the flexibility and the adaptability of the human mind, people are able to withstand the inherent pressures imposed, and instead even regulate the same to a certain extent. Nevertheless, even though the human mind may be able to block out a part of the pressures exerted, they do subconsciously evaluate the surrounding

environment on a continuous basis to reach an equilibrium position where they are able to let down their guard and relax. Therefore, productivity is the summation of multiple mental aspects, and relates to human psychological, physiological, and neural functioning changes (Lan *et al.,* 2010).

With regard to the structure, design and the general layout of office buildings, modern day literature (e.g. Akimoto *et al.,* 2010) expounds how they should be ergonomically designed, so that they leave a minimal energy signature. Incorporating specific comfort zones within them should contribute to increased employee productivity that is supported by available and existing literature on this topic. Akimoto *et al.* (2010) has concluded that from 28 temperature scenarios, incorporating the aforementioned factors into the design and layout of office buildings automatically contributes to a feeling of satisfaction within workers, irrespective of the circulation and the movement of the air within the building, its flow rate or the type of clothing worn. Akimoto *et al.* (2010) also concluded that employees further increase their comfort within the building by controlling and regulating the amount of fresh air flowing into the structure, as earlier discussed.

Lan *et al.* (2010) concluded that if employees are uncomfortable with the atmospheric conditions surrounding their workplaces, they tend to exert greater effort to cope with increased workloads. Haneda *et al.* (2009) also reached similar conclusions while conducting studies on how heat factors contributed to employee productivity. Hence, putting in the extra effort in adverse circumstances can contribute significantly towards ensuring that the equilibrium is maintained in the output generated by an employee (Lan *et al.,* 2010). Researchers have also concluded that the surrounding air temperature and associated conditions all contribute significantly towards deriving the output levels of the workers, since stifling heat decreased output levels from workers, while maximum output was observed in cooler and/or neutral conditions.

Steemers & Manchanda (2010) conducted an extensive study in India and the UK involving at least 12 situations to observe the extent to which heat, energy use and the extent of CO_2 in circulation in the atmosphere contributed to employee productivity and output. The study concluded that there was a direct relationship to the extent of energy utilisation within the building verses

mechanisation, illustrated by the greater use of artificial cooling efforts using air-conditioning equipment. Correspondingly, the level of occupant control was observed to decrease, contributing to individual discomfort and reduced functionality and/or productivity for employees and residents occupying the building.

A supporting study conducted by Deuble & de Dear (2012) regarding POE has concluded how the satisfaction level of building residents was found to be a function of their individual perceptions regarding the environment. Their study evaluated the perceptions of employees working in two locations in sub-tropical Sydney, Australia. It observed how people more aware of their environment were found to be generally more forgiving of their environmental imperfections, in comparison to their 'brown' counterparts who had a lower perception regarding the environment and related issues. Hence, people occupying green buildings having environmentally-friendly features like natural ventilation through operable windows were found to be less critical of their environments and surroundings.

Modern theorists have emphasised how important it is for modern and commercial structures under construction to be in conformity with established green building standards, so that they are comply with envisaged reduced carbon emission targets. Correspondingly, the inhabitants of such structures need to play a more active role during their occupancy, contributing towards ensuring the integrity and the wellbeing of the structures (Deuble & de Dear, 2012). Research on thermal comfort thresholds has demonstrated that individuals are more at ease in situations where they perceive being in control of their environment, irrespective of whatever the actual condition prevailing therein (Brown & Cole, 2009). The upcoming section evaluates aspects of ventilation and the corresponding indoor air quality with respect to its influence on workplace environments.

2.4.2 Ventilation and Indoor Air Quality

Good air quality in a workplace would contribute to reduced illnesses amongst employees, including instances of asthma, allergies and symptoms of SBS. This in turn would contribute to employees being more often at work, and ultimately increase workplace productivity (Fisk & Rosenfeld, 1997). However,

for the better part of the Twentieth Century, indoor air quality was perhaps simply linked to increased ventilation, and this by itself was considered all encompassing. However, it was only at the beginning of the 1990s that the concept of source control was developed, after it was realised that the inhabitants within the structures were not the only polluters, and therefore the rate of CO_2 emissions could hardly be stated to be simply a function of the number of individuals within a building (Bluyssen, 2010).

A proper ventilation system would be developed in consideration of multiple factors, including its ability to maintain the air temperature, control the humidity, the air speed, and the chemical characteristics of the air within the room or building (Chen, 2009). Hence, it is important to have the necessary tools in place to ensure that there is proper ventilation in a specific location, and have the necessary and required information regarding the overall layout of the entire structure. When we consider the atmospheric mix in a room to be at its optimum, we are actually referring to the ideal mix of a number of factors, including the air temperature and the associated chemicals in the air. Hence, to properly assess the ventilation of a location, we would need to consider all of these aspects. Chen (2009) is of the perspective that analytical and empirical solutions, computer simulations and associated experiments should contribute to a better understanding of the prevailing environment in an enclosed structure.

Huizenga *et al.* (2006) undertook an in-depth research initiative regarding air quality and thermal comfort, gathering a pool of over 34,000 respondents in the United States, Canada and Finland regarding some 215 buildings and associated structures. The results were revealing in that over 80 per cent of respondents confirmed that only 11% of the 215 buildings fulfilled all the established criterion of being properly compliant with thermal conductivity standards. Nevertheless, the survey concluded that 80 per cent of respondents were satisfied with around 26% of the structures regarding the quality of the air in them. Hence, it could be concluded that a vast majority of buildings, even in the developed world, fell short of the prescribed standards of air quality and thermal conductivity.

In recent years, there has been an increasing realisation towards ensuring that buildings are compliant with the established standards of thermal

conductivity, so that buildings may reduce their atmospheric signatures to the extent possible. In this regard, Singh *et al.* (2010) has concluded how people living in well-ventilated structures are more susceptible to natural influences, and would not be able to dictate their personal environment. Nevertheless, they are also found to be more accommodating of their circumstances and willing to adjust themselves to their surroundings.

Mumovic *et al.* (2009) conducted a survey amongst nine built up structures and concluded that if the sound levels were on the higher side within buildings, ensuring the presence of adequate and acceptable ventilation systems contributed to reducing the sound pitch within these structures.

A secondary study by Gratia & De Herde (2007) contributed to the understanding of how natural ventilation could be induced on hot days optimally utilizing a double-skin façade. Therefore, the proper orientation of the latter greatly influenced the wind flow within the building, which in turn affected the air flows within the structure.

Hummelgaard *et al.* (2007) conducted a study within five mechanically, and four naturally ventilated open-plan office buildings with regard to indoor air quality. It was concluded that the naturally ventilated buildings exhibited a greater level of comfort and satisfaction for the occupants.

A European Health Optimisation Protocol for Energy-efficient buildings (HOPE) study (Bluyssen *et al.,* 2011) involving some 5,732 respondents within 59 commercial buildings concluded how perceptions of indoor air quality, noise, lighting and thermal comfort were positive in over half the cases surveyed. Therefore, it was concluded that perceptions of comfort varied amongst individuals, and required more in-depth study. Furthermore, being able to control the hot summer temperatures translated into more comfort for individuals, although the somewhat opposite was concluded with regards to ventilation since a greater control of this aspect translated to lesser comfort levels on an individual level, even during the chilly winter months.

The aforementioned contributed to an understanding that there was a lot of scope in exploring how ventilation affected individual health for occupants inside a building. A challenge in this regard was the significant expenses involved, in terms of human resources, material and time, which perhaps

explains the reluctance of researchers in this sector (Hummelgaard *et al.,* 2007).

2.4.3 Lighting and Glare

The majority of members of the lighting community would have the same opinion that good quality lighting does more than adequate visual performance and avoid visual discomfort. Even though details differ among various models, there is some conformity that lighting quality includes consideration of the appearance of the space, energy efficiency, architectural integration and costs (Veitch *et al.,* 2008).

Lighting quality was analysed by Boyce (1998) where he stated that discomfort, issues and inefficient activities are carried out when there is presence of poor lighting. Indifferent lighting is created when the issues are resolved and this does not distract or offend the workers. However, it is unable to lift the human spirit. Also, if the discomfort and distraction are removed with high quality lighting, then suitable context conditions are brought forward along with uplifting the spirits through an aesthetic element.

Daylighting and views have also been analysed by researchers in field studies where they believe that personal control over workstations and productivity are influenced by these factors (e.g. Kroner *et al.,* 1992). Personal control workstations were able to establish a 3 per cent increase in the productivity levels of the workers in the new West Bend Mutual building from within a 16 per cent overall increase. Several other environmental and organisational factors contributed towards the remaining 13 per cent. Window area increase and access to an attractive outdoor view of the prairie landscape with a pond along with daylighting was the upgrade as part of the environmental changes. The Herman Miller building consisted of a similar setting. Private offices present along the window walls were removed from both buildings in order to increase the access. In this manner, the workstation partitions and window openings were accessible to many other workers. The old building had 30 per cent of the employees with access to the window wall in the new West Bend Mutual building, but now the percentage increased to 92 per cent (Heerwagen, 2000).

Additionally, Frontczak *et al.* (2012) conducted a survey on office buildings and found that office employees are more satisfied with their workspace and building when located close to a window in a private office. This may affect job satisfaction, work performance, and personal and organisational productivity.

Additionally, a POE used by Menzies & Wherrett (2005) to observe the level of comfort in four case study buildings found that architects consider comfort and productivity in their designs, but consider sustainability less often. They also found that construction design can influence the efficiency of multi-glazed windows, which means design factors predisposed occupant comfort. However, Menzies & Wherrett (2005) concluded that comfort and productivity in the workplace is related more to design factors than to sustainability factors.

Work stress and mood of the workers are reduced with the presence of sun penetration, daylight and natural view. Hence, productivity levels also increase. This aspect was not discussed by Kroner *et al.* (1992). Job satisfaction levels increase along with more positive moods, and stress reduction occurs where nature can be viewed through the windows, the sun penetrates and daylight is present (Kaplan, 1992; Heerwagen, 2000). However, there is an issue with the acoustics of such buildings that must not be ignored.

Visually open environment provides daylight and window access that is preferred by occupants, but at the same time is necessary to weigh the benefits and costs of managing such an environment. In the future, engineers and designers will be subjected to major challenges when they are required to optimise the levels of lighting, thermal, acoustic and air quality environments in organisations for the purpose of productivity and wellbeing.

Lighting quality contributes to organisational productivity, but the extra expense of considerate lighting design needs to be justified. Veitch *et al.* (2008) analysed two experiments into simulated office space, where impermanent office personnel worked below one of six lighting conditions for a day, and it was found that people who perceived their office lighting as being of higher quality rated the space as additionally attractive, reported more pleasant mood, and showed better wellbeing at the end of the day.

2.4.4 Acoustics

In the contemporary world, open plan offices and team spaces have become extremely popular (Sims *et al.,* 1998; Heerwagen, 2000). Due to this reason, it has been observed by various studies that people and phone noises are able to affect the environment of the office. This aspect has become a major concern since the noise of people talking can disrupt concentration levels, working memory and continuous logical thinking of an individual involved in cognitive work.

Private conversations cannot take place in open offices and the noise generated is able to influence the internal processes, especially when words can be distinguished. Research suggests that even though offices are able to provide the private space required for confidential discussions, they are still not able to manage the appropriate level of acoustics (Sims *et al.,* 1998).

Acoustical issues may aggravate in the presence of green building design strategies that lower surface polluting materials like carpet fabric panels and soft wall treatments. The modern buildings are mostly replacing their semi-permanent and wall panels with deconstructed and easy moving furnishings. A team space recent survey suggested that flexible and lightweight furnishings help make sound transmissions much easier (Sims *et al.,* 1998). High strategic performance outcomes were experienced with the development of team spaces, but this level of productivity lowered the individual concentration levels along with performance.

Literature also clarifies certain facts related to the increased responsibility and noise exposure on a working individual. With the help of various experiments, it was seen that the exposure to noise effects (high sounds, music, traffic noise) along with 'brain work' (binary-choice test) resulted in increasing blood pressure as noise was increased (Melamed *et al.,* 2001).

Mumovic *et al.* (2009) showed that while acoustic standards are demanding it was possible to achieve natural ventilation designs that met the criteria for indoor ambient noise levels when external noise levels were not excessive. Their study investigated nine recently built schools and he found that thermal comfort in the monitored classrooms was mostly acceptable but temperatures tended to be much higher in practice than the design assumed.

In regard to noise at night, Bluyssen *et al.* (2011) showed that noise exposure can affect the parasympathetic and sympathetic balance. Bluyssen *et al.* (2011) states that increasing the chance of successful assessment of cause-effect relationships in prospect indoor environmental quality (IEQ) investigations, seems to necessitate improvement in procedures applied to gather the relevant information.

Another recent study on office building by Jahncke *et al.* (2011) found that design of work environments has significance for office building worker wellbeing and performance. Their results showed that the participant performance, tiredness and motivation declined more in high noise compared to low noise. However, Frontczak *et al.* (2012) conducted a survey on office buildings and found that employees are in general satisfied with their workspace, even when they register high dissatisfaction with sound privacy, temperature, noise level, and air quality.

2.4.5 Building Standards

As mentioned earlier, wellbeing and control over thermal conditions in particular are necessary. Control over environmental conditions in office buildings can improve work efficiency as less people suffer from ailments caused by sick building syndrome (Leaman & Bordass, 1999; Karjalainen & Koistinen, 2007) which is a term that has been coined for a set of clinically recognisable symptoms and ailments without a clear cause reported by occupants of a building (Israeli & Pardo, 2011).

Indeed, there have been very visible and appreciable innovations and improvements in building standards, with respect to aspects of the health and wellbeing of residents when compared with the 1970s. This was particularly realised when designs were measured in consideration of definitions propounded by Levin (1995), who described the same with respect to both the individual and the surrounding environment as a healthy building minimally affecting both the individual and the surrounding environment.

Bluyssen (2010) explained how a healthy building contributes to the wellbeing and the health of the inhabitants, including their productivity and morale. This in turn exposed how productivity in commercial buildings was a function

of aspects related to comfort, employee satisfaction and the complexity of the task undertaken within the building.

It is increasingly important that aspects of indoor air quality (IAQ) are addressed by designers to ensure that occupants and the environment are not adversely affected. To this end, aspects of heat flow within the structure, lighting, acoustics, privacy, security, and sustainability require specific attention. It is important that structures erected have minimal adverse effect on their surroundings since otherwise it would ultimately end up affecting the occupants in a roundabout way (Loftness *et al.,* 2007).

In understanding the indoor environmental quality associated with a structure, it is important to understand that we are herein not just referring to the air quality within the unit, but our focus also encompasses aspects of light, thermal schematics, acoustics, vibration, and related indoor environment aspects (Levin, 1995). Thus, a healthy building has a minimal adverse influence on its inhabitants and instead goes to increase the productivity and morale of the residents. Therefore, a healthy building is not just concerned with the absence of adverse factors, but is also equally concerned with the presence of positive aspects that benefits the stakeholders.

Fisk & Rosenfeld (1997) have established a strong and direct relationship in incidences of respiratory diseases, symptoms of allergy and asthma, SBS and worker performance against the layout and the structure of a building. It has been found that appropriate ventilation contributes to a 9-20 per cent reduction in respiratory illnesses, a 0.48-11 per cent increase in productivity, plus a 25-50 per cent reduction in electricity and energy costs. Healthy building syndrome is a term used to describe the absence of SBS.

Mendell *et al.* (2002) stated that the correlation and relationship between environmental factors and the health and wellbeing of a resident is becoming increasingly evident and shortcomings in controlling the surrounding environment is demonstrated to have a significant impact and influence in the extent to which an individual is able to maintain their wellbeing and health. Correspondingly, there are significant adverse expenses associated therein in terms of health care costs, lost working days, and personal costs in situations

where individuals are unable to maintain their health which makes it all the more important to invest in ensuring the continued wellbeing of the individual.

To summarise, there are shortcomings in the clear and concise demarcation and definition of healthy and green buildings and in their inherent differentiations. The concept of 'healthy buildings' is an evolving one, with further studies clearly needed. While IAQ is a major factor in ensuring the wellbeing of building occupants, it is nevertheless not the only determinant in this regard, as there are a multitude of other factors that need to be considered and kept in perspective.

2.4.6 Spatial Design and Privacy

The layout and the architecture of a building could fulfil the requirements of a certain individual but need not necessarily fulfil the requirements of everyone (Langston *et al.,* 2008). Hence, there is much to be understood with regard to how individual office environments affect productivity in varied organisations. This section attempts to explain the relationship between the architecture of an office building and how employees perform therein.

It is very important that the design and the general layout of the building be cognisant of the requirements of the majority of the population in the building, facilitating their work to the extent possible. Therefore, the efficient flow and exchange of information between occupants on what contributes to their output and productivity is an essential focus of architects towards designing efficient and healthy buildings (Loftness *et al.,* 2007).

Sustainable design initiatives entail the use of building materials that are non-polluting and have a lower energy signature during their lifetime. Correspondingly, such materials need to be durable and be recyclable too. The utilisation of sustainable materials enables the structure to be in place over an extended time period, while simultaneously being cost-effective during the lifetime of the building (Loftness *et al.,* 2005). Therefore, a sustainable building should contribute to the health, productivity and overall quality of life of its inhabitants.

Sundstrom *et al.* (1982) explained how reduced visual and acoustical privacy levels for the management cadre were observed more liberally for employees

who were moved from individual offices having 60" (1.5 metre) high walls to hall style seating arrangement having up to 78" (2 metre) walls.

Similarly, Brill *et al.* (1984) has undertaken studies towards investigating the extent to which workplace enclosure heights affect privacy, and concluded a positive relationship between height and privacy. Nevertheless, there are a number of considerations in this regard, and all of them need to be kept in perspective by interior designers and architects during the planning and design phase of office workspace.

Studies by Lee (2010) explored how job satisfaction was influenced by the employee's performance with respect to such aspects as privacy, interaction, and acoustic issues during a comparison of the situation in five LEED-certified buildings. It surprisingly demonstrated that people working in isolation in cubicles with high partitions demonstrated reduced satisfaction levels in comparison to individuals given the opportunity to interact amongst their colleagues. Correspondingly, high sound levels in the workplace contributed to decreased output amongst employees. It was observed how the bullpen type, open-plan office structures resulted in happier employees with higher productivity, in comparison to employees in cubicles enclosed by either high or low partitions. It was therefore concluded that the bullpen type seating arrangement was more conducive, instead of the high or low partitioned cubicles, even though the latter seemed to offer more privacy to employees.

2.4.7 Ergonomics

A 'workplace' is concerned with how an enclosed space would provide functional and psychological input towards producing value in the output generated therein. Correspondingly, the enclosures, layouts and associated parameters provide value as has been highlighted by Purdey (2010). The employees determine the factors to be prioritised, with Haynes (2007) being of the view that the design of the workplace significantly influences how employees subsequently perform therein.

Studies by Klitzman & Stellman (1989) evaluated the relationship between the layout of the workplace and employee productivity. It was concluded that factors such as poor air quality, high noise levels, uncomfortable ergonomics, shortcomings in privacy, and so on contributed to an unsatisfactory work

atmosphere. It perceived how workers seemed to differentiate between specific physical environments and overall general working conditions, with the latter including aspects of workload, independence in decision-making and the bond between colleagues.

Studies by Paul *et al.* (2008) sought to assign values on the comfort and satisfaction perceived by employees in green buildings versus those in two traditional structures, using a questionnaire. This involved the employees rating their respective offices on aspects of aesthetics, serenity, lighting, acoustics, ventilation, temperature, humidity, and overall satisfaction levels. Interestingly, it was concluded that there was no major difference in perception about the workspace between employees in the green building versus employees in the normal structures. Nevertheless, employees in the green building did perceive their work area to be warmer, and this was considered a negative trait. The researchers in this particular study were of the view that aspects of aesthetics, serenity, lighting, ventilation, acoustics and humidity did not play a major differentiating role in determining worker satisfaction in the workplace at both locations.

Gutwin & Greenberg (2002) evaluated worker perceptions in a medium-sized organisation towards having a perspective on how workers therein perceived their stations in relation to that of their colleagues. It was concluded that in such locales it was more convenient to maintain a high level of workspace awareness considering that there was no appreciable measure of dynamism or a high information load involved (Purdey, 2010).

Workspace awareness contributes to situational awareness (Gutwin & Greenberg, 2002). The latter is concerned with how individuals interact with colleagues on-site, perhaps similar to how pilots and air traffic controllers synchronise their activities. Nevertheless, such work paradigms do lack in the high level of dynamism, information load and collaborative work standard in similar situations elsewhere (Purdey, 2010).

To summarise the studies, there are multiple volumes that document a 'workplace', in consideration of the awareness amongst employees and employers towards the specifics and ergonomics associated with increased employee productivity. The forthcoming section will evaluate job satisfaction

and productivity from a business perspective, since this is a primary focus of this research.

2.5 Job Satisfaction and Productivity

2.5.1 Human Resource Management

Human resource management (HRM) and individual tasks are affected by organisational satisfaction and productivity is affected by the information systems available and the way in which people deal with knowledge (Hoel *et al.,* 2011). The commitment of the workers (Guest, 2011), the role they play (Wood, 1999) and the organisational objectives are determined by the unitary HRM system. The methods of this system deal with the management of the entire organisation (Marchington & Wilkinson, 2005). HRM usually increases the productivity of the business when external competition is on the rise (Renee, 2008).

The idea of 'best practice' HRM is being studied and this idea is also called 'high performance work systems' (Appelbaum *et al.,* 2000), 'high involvement' (Wood, 1999) and 'high commitment' (Guest, 2001). The managers are trying to use this idea to create a productive workforce that operates as a team (Gould-Williams 2004). The HRM performance models deal with the important issue of how workers react to the HRM practices (Purcell & Kinnie, 2006).

Previous research showed that the combination of different HRM methods is more effective than when they are used separately (Renee, 2008). The firms which try to use single HRM methods will not get very good results and a significant increase in the productivity of the employees will only be seen when several HRM practices are use together (Gould-Williams, 2004). The behaviour of the workers is classified as the ones dealing with affective or attitudinal results such as job satisfaction and commitment to the organisation, known as organisational citizenship behaviour (Purcell & Hutchinson, 2007). HRM methods (Gallie *et al.,* 2001), the management's credibility (Snape and Redman, 2003) and other organisational practices are interpreted by the workers as a way of determining the commitment of the organisation to its workforce (Wood & Albanese, 1995).

Armstrong and Baron (2005) proposed the idea that people and their skills, knowledge, experience and their desire to use all their abilities for the development of the organisation they are working for are mainly responsible for increasing the competitive advantage of the company and leading to its overall success.

Renee (2008) conducted a study on the basis of a preliminary staff survey of workers and found the HRM methods used can contribute a great deal to the performance of the workers. The research also found that the link between employees and management had to be a supporting and trust-based relationship so that the employees would be motivated to increase their performance.

Organisations that tried to increase the wellbeing of their workers, improve their job satisfaction and promote a balance between work and other activities were able to get more from their employees, and productivity increased by creating a solid long-term connection between the workers and the employees based on support and trust.

War (2002) stated that the wellbeing associated with work is connected to the satisfaction that the workers have with their jobs. This satisfaction depends upon factors such as salary, colleagues, working conditions, supervisors, job security, opportunities for training, team work and the type of work given to them.

2.5.2 Management Styles

The management style refers to the way in which management is delivered and depends upon the behaviour of the people involved and their personality (McGuire, 2005). Schleh (1977) believed that management style is responsible for combining various functions and operations into a single whole. The management style is the set of rules guiding the workers on how something is supposed to be done and it utilises the skills of the workforce. It is a broad framework for things to be done by the workers, it determines how the workers function within the organisation, and it allows the managers to depend on the initiatives of the people working for the organisation.

Management style can be effective when the leadership continuously moves forwards and enables the workers to reach a target that has been selected by the entire group of people involved. It determines the way in which managers pursue various matters and the way in which they go after the objectives of the organisation by using the different resources that the organisation possesses to get results.

McGuire (2005) studied the basic management styles employed by managers in the pharmaceutical sector and discovered persuasive, consultative, charismatic, transactional, delegating and transformational styles. Worrall & Cooper (2004) conducted a survey in the UK and discovered that managers who employed bureaucratic and restrictive styles of management and these styles did not get good results for the company and they did not promote the development of creativity and innovation amongst the workers.

The performance of a company is directly linked to its leadership and the interconnections between motivation and performance of the workers and the style of leadership have been analysed by many researchers (e.g. Iok, 2004). Clear vision and empowerment are the transformational leadership qualities that are vital for increasing the commitment level and job satisfaction of the workers (Iverson & Roy, 1994). A flatter organisational structure uses this kind of leadership style and such organisations are found in the west and they have low power-distance characteristics (Chen *et al.,* 2001).

The productivity, commitment, satisfaction and contribution of workers can be increased when the management of the organisation empowers them (Malone, 2004). Iok (2004) conducted research that showed the impact of organisational culture and styles of leadership on the commitment of the workers to the organisation and their level of job satisfaction. The managers of Hong Kong and Australia were surveyed for the study. They occupied middle or senior positions in the management hierarchy and the research showed that the style of leadership had a good effect on the commitment and satisfaction of the workers. The sample of Australian managers showed greater commitment to providing a culture of innovation and this had a clear and positive effect.

Management researchers have discovered and classified various styles of management and there is a certain overlap evident. Management styles are

quite homogenous with small differences between them. These differences are because different business organisations have different structures and they possess workers with different natures. Cultural trends and influences affect the style of management and therefore countries may exhibit diverse management styles because of these cultural factors.

2.5.3 Evaluating Staff Performance

Strategic management holds performance improvement at its core. More importantly, there are three dimensions in which strategic management lies, namely theoretical, empirical and managerial (Cameron & Whetten, 1983). The test for any strategy is its performance, so performance is the entire centre of strategic management (Schendel & Hofer, 1979). In order to evaluate various possible options and strategies for business success, managers opt to devise a performance plan (Venkatraman & Ramanujam, 1986).

It has been stated by Marr & Schiuma (2003) that the performance of the business needs to be constantly monitored by the business managers. Measuring the performance of the business is a very in-depth and complicated process and requires participation from practitioners and experts from various diversified areas of HRM, information technology (IT), marketing, accounts and so forth. Nonetheless, during recent years some very new and unique approaches for business performance have been brought to light, such as activity-based costing (Marr & Schiuma, 2003) and shareholders' value (Rappaport, 2000). Introduction of new measurement tools most specifically the balanced scorecard (Kaplan & Norton, 1992; 1996) and tools for assessment like business excellence models have made an impact in the corporate world.

It is quite normal to support the argument that in an upgraded or new work environment, workers tend to be happier and so they perform better (Schwede *et al.,* 2008). With a change or upgrade, people become more focused (Adair, 1984). Many examples from real life have been observed in which the performance of the workers have increased due to the positive changes in environmental aspects. A significant 8 per cent increase in the performance of employees at a post office was observed upon the improvement in lightning and acoustics (Browning, 1997). When the indoor ambience of an office was

improved, a 10 per cent inclination towards performance was observed (Roelofsen, 2002).

A study by Veitch & Newsham (2000) found that a valuable improvement in mood, room appraisal, environmental satisfaction and self-assessed productivity was observed from the introduction of lighting dimming controls. Kruk (1989) gave much importance to the furniture present in the office as he claimed that a comfortable well-designed chair increased the performance of the employees by 27 per cent whereas well-defined office furniture increased it by 15.4 per cent. If the workplace is full of innovation and creativity than it is likely to attract and retain more workers who possess creativity (Haynes & Price, 2004). Also, it has been observed there can be a direct and strong relationship between employee environment and employee satisfaction (Carlopio, 1996).

2.5.4 Information Technology

Various sophisticated information technologies have been developed in the previous decade, including electronic messaging systems, collaborative systems, executive information systems, group decision support systems, and other technologies that employ advanced information management to allow multiple parties to be involved in organisational activities. In recent years, the way IT affects work life is being extensively discussed. The measures used to determine the effect of IT essentially concentrate on productivity. To provide justification for technology investment with respect to the way it affects an individual's work, it is becoming more and more important to have an information systems manager. In this section, the effect of IT on the organisation and the efficiency of employees is studied.

It would be more appropriate to define IT as a 'general purpose technology' rather than as a traditional capital investment (Bresnahan & Trajtenberg, 1995). IT refers to computers and other related digital communication technology, and is capable of decreasing the expenses pertaining to coordination, communications and information processing. This huge decrease in computing and communication expenses brings about anticipated large-scale economic restructuring. Computerisation has affected almost every modern industry to a large extent. The economic effect of general purpose

technologies are, in the majority of cases, greater than would be calculated by just multiplying the quantity of capital investment dedicated to them by a standard rate of return. In contrast, these technologies have greater economic advantages because they bring about further corresponding innovations.

Manual information processing is expensive, and it is this fact that has given rise to majority of the previous century's most successful and well-known organisational practices. For instance, there can be a decrease in communication costs when the organisational structures are hierarchical as they reduce the number of communications networks needed to link various economic players, in comparison to decentralised arrangements (Malone, 1987; Radner, 1993). On the other hand, Brynjolfsson & Hitt (2000) studied the manner in which adjustment to IT costs and capacities brings about changes in the working arrangements and corporate strategy that enhances the need to have skilled workers. In addition, the beginning of the 1990s saw firm-level investigations determine the impact of computers on the efficiency levels of operations.

The connection between productivity and IT is also affected by several hidden factors. Brynjolfsson & Hitt (2000) determined a model for a firm's 'fixed effects' productivity. The model separated the IT benefits of the firm into two classes: the benefits due to the difference in IT investments made by the firms from time to time and the other class consisted of the benefits due to the properties of the firm. The fixed effects model of the firm had an IT coefficient that was 50 per cent lower than the results of the ordinary least squares regression.

Brynjolfsson & Hitt (2000) have analysed the effects of IT on the increase in productivity and not on productivity levels. The study involved data relating to more than 600 firms from 1987 to 1994. The one year variations in the IT were compared to the one year variations in the firm's productivity and the results showed that the measured costs of the computers and their benefits were not different from each other. Some researchers have attempted to estimate the organisational effects directly to show their relationship with IT investments and how several complementary effects can be adopted by firms to increase their economic performance.

The determination of a relationship between organisational change in the firm, the IT investments of the firm and its economic performance does not prove that the methods involved complement each other. Only a complete structural model can show this by displaying the production links and demand drivers associated with each of the elements involved. Athey & Stern (1998) have studied the factors involved in the empirical determination of the complementary correlations.

Research work done at the industry level reveals the greater usage of computers needs more human resources and there is a positive correlation between the requirement of skilled labour and the investment in modern machinery (Berndt *et al.,* 1992; Berman *et al.,* 1994; Brynjolfsson & Hitt, 2000).

The macro organisational structure of the firms is affected by IT and this relationship has been researched about with respect to factors such as the diversification of the firm, the firm size and the vertical integration of the firm. Brynjolfsson & Hitt (2000) have displayed that the mean firm size in an economic sector declines when IT capital in that sectors grows.

2.5.5 Worker Productivity

The American Society of Interior Designers conducted a survey upon 200 business decision-makers. The results of this survey stated that productivity levels for employees increase with the improvement in office design (Heerwagen, 2000). This was believed by 90% of the respondents of the survey. At the same time, 97 per cent stated that productivity must be correlated with the level of investment in order to make it worth the cost.

The environment consists of five factors that are integral to environmental quality and have the ability to affect the productivity levels of workers (Heerwagen, 2000). They are privacy, distractions, flexibility of space and customization, aesthetics, and access to resources and people. Productivity measurement is difficult for non-industrial workplaces especially in the case of repetitive work. This is a key problem for industry and is expanded by the performance metrics that have been applied by some organisations for their workers. These metrics include designing, analysing, writing, policy development and problem solving that are also referred to as 'knowledge work'.

Hence, to manage this issue, combinations of self-administered methods or self-ratings are carried out within the office settings.

Productivity related self-assessments have brought forward the strong correlation between air quality and thermal factors. In the UK, over the past 20 years, occupant surveys have shown that employees who have control upon their building environment have greater levels of perceived productivity and comfort (Leaman, 1999). At the same time, there is much more productivity in buildings with air conditioning or proper natural ventilation. In Europe, 107 buildings with more than 11,000 workers were analysed as part of two cross sectional studies. These studies clearly showed that illness symptoms and absenteeism are lower in office buildings that have a control upon their ventilation and temperature. The level of productivity is much higher in such buildings than the control groups (Preller *et al.,* 1990).

Research is difficult for objective productivity outcomes in field settings due to only limited studies that have been found. However, the ones found stated a strong correlation between work performance levels and environmental factors. The impact of 20-year old carpet on work performance was studied by the International Centre for Indoor Environment and Energy in Denmark as a field experiment (Wargocki *et al.,* 1999). The workers were not told what was exactly being tested, which is why they hid the carpet behind a screen. Ventilation and temperature were kept constant. The results clearly stated that in the absence of the carpet, the workers were able to perform 6.5 per cent more productively than the normal on a text entry task. With the help of this study, it is possible to enhance the direct effect of air quality upon performance levels. Several researchers have also stated that illness and absenteeism are also responsible for impact along with poor air quality on performance levels (Wargocki *et al.,* 1999).

The literature has shown that comfort, acceptability and enhanced performance are contributed by the required level of temperature and ventilation, presented as personal control over environmental conditions (Brager & deDear, 1998). The productivity levels of logical thinking tasks, typical clerical tasks, rapid manual work and skilled manual work would increase by 2.7 per cent, 7 per cent, 8.6 per cent and 3 per cent respectively, if only a temperature control of just three degrees (plus or minus) was carried

out in the work environment (Heerwagen, 2000). This fact was observed in the review of research on indoor environmental quality.

To manage the preferred extent of comfort, a certain level of effort and time needs to be applied. However, levels of personal control could affect the performance of workers. Research clearly indicates that the employees suffering from distraction due to discomfort had lower levels of productivity and task focus since they were involved in coping behaviours (Heerwagen, 2000).

Productivity, comfort and personal control have a complex relationship. A review article upon air quality and productivity showed that the highest level of performance outcomes may not necessarily be due to comfort levels. This aspect was recognised in an experimental study. At times, employees prefer to be warmer or cooler rather than being in a neutral comfort state in order to apply their highest level of productivity. In the case of thermal sensation, it is observed that creativity or performance tasks usually improve in warmer temperatures (Heerwagen, 2000).

An emotional state of wakeful relaxation along with arousal reduction is usually observed in slightly warm temperatures. The relaxation is linked to creative problem-solving (Melnechuk, 1988). Apart from air quality and thermal factors affecting productivity, lighting also has a vital effect upon energy consumption and performance levels. Hence, in the contemporary office world, high quality and efficient lighting methods are being used to achieve maximum productivity levels.

The lighting system, features and computer environment along with glare reduction are some of the aspects lighting and productivity studies are now focused upon. Many of the studies have shown that with the help of indirect lighting, self-productivity ratings would increase (e.g. Hedge *et al.,* 1995). On the other hand, with parabolic louvre systems, objective productivity levels are more likely to increase (Veitch & Newsham, 1998). Individual differences are present in lighting preferences, which is why personal controls allow satisfaction levels to be higher and energy consumption to be lower (Heerwagen, 2000).

2.5.6 Job Satisfaction

In all human activities, satisfaction plays a vital role, and it is required at the organisational level to do business successfully (Isa *et al.,* 2011).

Jang & Kim (2009) say that the satisfaction of people indicates the extent to which the people are happy with their surroundings and their lives. Several features of human satisfaction have been pointed out by them. These features include the acknowledgement and support of personal targets and societal values. People can enhance their personal satisfaction by becoming involved in the affairs of the society and make efforts to create a better society.

The amount of satisfaction that a person gets from performing an activity affects the level of performance that person, and satisfaction amongst the workers increases their productivity levels and efficiency and the organisation benefits from this (Oh *et al.,* 2011).

Urban & Mazurek (2011) stated that satisfied people are happy with their surroundings and research shows that the people can be motivated and their satisfaction can be increased when they are included in the change process (Wright *et al.,* 2005; Hampel & Martinsons, 2009). A community can contribute towards society when it is satisfied, and this link can positively affect the performance of the people.

Jernigan *et al.* (2002) proposed that work satisfaction depends upon the satisfaction that the workers gain from their work and with the conditions in which the work is done. A narrow definition of job satisfaction is that it is a good feeling a person gets from doing ther job (Locke & Latham, 1990).

Fisher *et al.* (2004) believed that a rewarding job can produce good feelings in the workers and this contributes to their job satisfaction and they perform better. Renee (2008) agreed that job satisfaction depends on the extent to which the employees gain satisfaction from the working conditions and the physical work environment of the workplace.

2.5.7 Absenteeism

Absenteeism has always been regarded as an important and prevalent issue in the industry. A number of theories have been formed and many studies have

been undertaken in an attempt to determine the reasons for absenteeism. Most likely, the fact that absenteeism is caused by employees who want to prevent a dissatisfactory or uncomfortable work situation is one of the most common theories. Nevertheless, absenteeism has been described as a subject that has to be studied, an issue to be considered, and a problem that has to be resolved (Obasan, 2011: p.29). In addition to direct costs related to absenteeism, there are indirect costs as well. These include reduced productivity and turnover, potential decrease in revenue, and employing casual staff (Cole, 2002).

Since absence is considered as one of the ways of avoiding stressful work conditions, a number of studies have been performed to understand the link between absenteeism and job satisfaction. Luthans (1995) stated the research has mainly indicated an inverse relationship between absenteeism and job satisfaction. This means that absenteeism is high when job satisfaction is low, and there is low absenteeism when job satisfaction is high. Although this relationship between the two factors is determined to be fairly average, the basic assumption is that absence does occur, at least partly, due to low job satisfaction (Anderson, 2004).

According to Robbins & Judge (2013), there are more chances of productivity leading to satisfaction rather than the other way round. This is because employees naturally feel content when they perform a good job (increased productivity). Moreover, better pay level, increased rewards, and chances of promotion can increase due to higher productivity, and all these benefits lead to job satisfaction.

Wyon & Sandberg (1990) found that when each worker is provided with separate temperature control, SBS symptoms and absenteeism reduces, individual productivity increases by 0.2 to 3 per cent, and 25 per cent of conditioning energy is saved (e.g. Wyon, 1996).

Overall, research shows that for the success of an organisation, employee satisfaction is quite essential. In organisational behaviour, job satisfaction is a widely studied factor since it even impacts other organisational factors such as absenteeism, productivity, and turnover. According to Atchison (1999), several firms significantly focus on employee satisfaction initiatives in order to

improve productivity, decrease turnover, and to facilitate the firm to become successful.

It is a big problem for firms when employees do not reach the workplace when scheduled. It has been concluded through several studies that absence has many aspects involved and is impacted through various reasons, which could be personal or organisational or both. One of the aspects that influences employee motivation to attend work is job satisfaction. The link between absenteeism and job satisfaction was studied by several researchers, however, no link was observed between both variables in some studies, while in others, a weak to average link between the variables was observed.

2.6 Job Complexity

Through the reading of previous studies about job complexity the researcher found that there was considerable debate on this matter. In this section there is an explanation related to the work complexity which is a manifesting quality for the evaluation of the latitude, the governing qualities and the extra work done by people (Shalley *et al.,* 2009).

In the last few years before 2009, the way of working and extent of work in organisations have changed largely because of technological advancement that has presented strict competition, lesser job opportunities and more talented people along with lower business scaling (Shalley *et al.,* 2009). This has urged workers to present themselves as more talented and energetic whether their job demands so (Amabile, 1996; Mumford & Gustafson, 1988).

Furthermore, creativity should be evaluated continuously as it is affected by the outside factors and the inside sentimental process, both at universal and minor levels (e.g., Mumford & Gustafson, 1988; Steiner, 1965). Creativity is needed largely in some jobs whereas in others it is not required so crucially and work can be done without it. Previously, it was realised that the mode of working can be a changeable process and permanent factors can affect the creative capacity of the worker and their job performance (Shalley *et al.,* 2000). However, in jobs that require innovation, worker performances are enhanced and creativity is also shown to be present (Shalley & Gilson, 2004).

There is a great deal of research work that demonstrates how the working environment can promote or inhibit creativity of employees at all levels within an organisation. Employees are also largely affected and changed by their responsibilities (Hackman & Oldham, 1975), the way of their working and the basics of their jobs and their learning to do their work successfully (Latham, 1989). So work done is completely affected by the external environment. To understand this behavioural science, it is necessary to evaluate the attitude of employees at their jobs. Morrison (1993) said in this context that the attitude of an individual is affected by environmental factors and changing inside factors.

Creativity and type of job are found to be interrelated but they are not examined with the required working capacity and context (Amabile, 1988; Oldham & Cummings, 1996). However, the researchers were hopeful that the working capacity, responsibility and creativity of the employees for complex jobs were much better than those who do simpler jobs and tasks. They were in fact trying to explain the better working opportunities and in turn performances of workers in complex jobs than those in simpler jobs. So, it was found that the type and complexity level of job determines the performance and creativity of workers.

It was presented by the researchers that the extent of work complexity can be obtained with the help of the three-digit occupational codes and the DOT substantive complexity measures that was presented by the analysts at the United States Department of Labour. It gives a job code that is related to the activities performed by a worker during a job and the requirements needed by the job. The DOT data is generally available and common along with the test-retest reliability that is more obvious and authentic in various jobs (Xie & Johns, 1995). DOT explains and defines substantive complexity as the nature, working capacity, responsibility and mode of job and if there is any rite or freedom to take decision or manage the task or not. Previously it was thought to be a part of job function to define all these things (Roos & Treiman, 1980). It was also seen to be related with the various psychological factors and variables (Shalley *et al.,* 2009).

2.6.1 Knowledge Workers

The literature has shown that that expertise and specialised knowledge are gradually significant to organisational performance and are replacing capital as the basis of social status and power (May *et al.,* 2002). Also, there has also been a discussion in the literature on the way firms limit the work autonomy of knowledge workers. May *et al.* (2002) states that since knowledge work jobs are less uniform than conventional professional jobs, there are spaces for an organisational-specific knowledge base. This suggests that structural contexts are critical to the establishment of knowledge and the expertise status of knowledge workers.

There are two main sources of knowledge acquisition, which include formal education and job experience. Both these factors are reflective of personal resources, which are made available to an employee (Gist & Mitchell, 1992). Research has shown that having updated experience in a specific field is very important for creative success. This is because immersion in a domain over a certain time period leads to a certain degree of familiarity that is needed for creative work (Weisberg, 1999). Even so, task familiarity leads to repetitive performance through deliberate practice of some activities (Ericsson *et al.,* 1993). Task knowledge is considered a crucial factor in forming self-efficacy assessments (Gist & Mitchell, 1992) and creativity performance (Amabile, 1988), where we can expect to see a link between creative self-efficacy and job-related knowledge is expected.

Creativity entails the need of what has been previously performed in the past and what has in the past made up the status quo. When employees come closer to comprehending the elements of their job, they are more likely to feel innovative in their respective positions. Education experiences are also imperative in developing appropriate mental faculties (Tierney & Farmer, 2002). This will allow proper enhancement of diverse schema and perspectives. Education also increases exposure to numerous perceptions and viewpoints. Additionally, it affirms the use of diverse problem-solving skills and experimentation used in creative work. This is because of the link noted between knowledge and creativity and the fact that knowledge is an eminent source of self-efficacy evaluation (Tierney & Farmer, 2002).

A study by Scott & Bruce (1994) stated that workers who accomplished difficult jobs were likely to get more knowledge and polish their internal talent and self-esteem and gather more knowledge along with greater creativity in their work. On the other hand, workers with low growth strength need have lower experiences, knowledge and self-esteem.

2.6.2 Employer-employee Relationships

Robbins *et al.* (2009) states a dimension that affects job satisfaction is the extent to which co-workers are friendly, knowledgeable and supportive. They found that workers who had supportive co-workers were more satisfied with their job (Aamodt, 2004; Robbins *et al.*, 2009). This is for the most part because "the work group normally serves as a source of support, comfort, advice and assistance to the individual worker" (Luthans, 1995; p.127). However, research by Salancik & Pfeffer (1977) found that workers observe the levels of satisfaction of other employees and then model these behaviours. For this reason, if a firm's veteran employees work hard and talk positively about their work; new workers reflect this behaviour and become mutually productive and satisfied.

Complexity levels make jobs different from one another. The considerably complex and difficult job tasks that involve not only the mental working of an individual but also changeable working tasks have been proven to be more positive for workers and provide them with new experiences and developed mental work (Kohn & Schooler, 1983). Complex jobs require more mental working and thus provide the worker with new learning and knowledge from their experiences. Shalley *et al.* (2009) found that simpler jobs do not require as much mental work as in difficult jobs. Whereas others said that complex jobs give greater working span and also provide chances to work with individual rights and responsibilities at a higher level (Campbell, 1988; Tierney & Farmer, 2002).

According to Eden (1990), supervisors play a very crucial role in forming efficacy beliefs of employees. Solid, confident behaviour is said to be a pre-requisite for managing employee creativity. Supervisors are a very important mechanism for determining the level of self-efficacy, indirect learning, oral persuasion and modelling. Role modelling done by supervisors is another

important factor in enhancing creativity and also plays a vital role in effective development of efficacy where complicated activities of coping and performance are concerned (Tierney & Farmer, 2002). Employees acquire substantial information, which is helpful in shaping their efficacy views from their interactive task environment (Gist & Mitchell, 1992). On the other hand, employees tend to focus on indications from members of their work environment, which helps to shape views corresponding with creative acts, including perceptions of their capabilities (Tierney & Farmer, 2002).

It is imperative to persuade employees that they are capable of being innovative through verbal expressions of confidence, trust and praise, because it helps to formulate positive and innovative self-efficacy perceptions (Tierney & Farmer, 2002). Additionally, it helps in drawing out positive emotional reactions from an employee, which, in turn, is again favourable with efficacy. In 1992, Gist & Mitchell (1992) postulated that because employees tend to lack enough information in order to estimate the success of their tasks, models that provide useful performance strategies are used in order to gauge the level of their performance efficacy. Supervisors may also indulge in certain acts, namely verbal persuasion, that is favourable in leading to self-efficacy (Tierney & Farmer, 2002).

2.6.3 Collaboration

Those people who have the chance to perform a complex job have more chances of developing understanding about their personal and social responsibilities. Moreover, this allows them to perform more creatively. So, such workers are always trying to find jobs that may enhance their talent and help them to perform more innovatively than simpler and routine activities.

The complexity levels of jobs determine the extent of work effort required by the employees. The information overload model found that working capacity and information processing are limited by individuals**.** The stress loading works imply the more information, work and responsibility on the individuals and the need of more work than expected by the job itself. For simpler jobs (i.e., jobs of low complexity), the responsibility and work are much less, which ultimately reduces the exposure to noise and performance is less affected by this factor. On the other hand, complex jobs and higher exposure to noise also

increase stress; decrease the extent of working and performance in those complex jobs (Melamed *et al.,* 2001). Similarly, more responsible work implies the negative and dangerous psychological reactions and factors (like less happiness in accomplishing tasks and higher blood pressure levels).

Robisson (2009) pointed out that employees who enjoy working with their supervisors were more satisfied with their tasks. Furthermore, a study by Bishop *et al.* (2000) about productivity, satisfaction and work in the manufacturing sector found that satisfaction with supervisors was related to organisational and team commitment, which in turn led to higher productivity and greater willingness.

2.6.4 Mobility

High levels of occupational achievement can hardly be obtained by staying in just one job (Van, 2001). Job mobility is a prerequisite for career advancement. Changing job allows individuals to try out several jobs to ascertain their comparative advantages. Job mobility tolerates individuals to take advantages of other job opportunity, thus surveying as a mechanism for upward social mobility.

A survey was established by Herbert (1954), as cited in Neal (1998), to explore worker mobility. In this survey the researcher devoted considerable attention to what he called the “complexity" of worker mobility. Also simple job shifts occur when workers change employers but continue doing the same type of job. Complex shifts occur when workers not only change employers but also change tasks.

In a physical office setting the work done could have similar qualities of dynamism, high information load, complexity, variable workload and risk (Gaba *et al.,* 1995). The individual workload or job requirements determine the reactions of the workers to the environmental stimuli (Sutton & Rafaeli, 1987). Purdey (2010) had shown that the complexity of the job did not influence the reactions of the employees to different environmental situations related to architectural privacy.

Carlopio & Gardner (1992) and Zalesny & Farace (1987) have shown that the density of the workspace negatively impacts workers having complex jobs and

the reverse case is also true (Purdey, 2010). The higher workspace density positively affects job satisfaction and the exchange of information. It also decreases the effects of conflict and ambiguity for the workers. The job complexity for the surveyed workers was determined by the research, but Fried *et al.* (2001) said that the inconsistencies that have occurred in the past can be accounted for by the exclusion of moderator variables like organisational tenure (length of service). This is an important variable that shows how much the individual knows about the organisation.

Tenure can moderate the negative response to the density of the workspace. The workers who serve longer could develop a better way of interacting with others and managing complex work situations, but the increased tenure could either improve or worsen the impact on reactions that influence the workspace density and the complexity of the job (Purdey, 2010).

Purdey (2010) shows that for a highly complex job with a long tenure a negative relationship exists between the density of the workspace and the attitudinal variables, which includes job satisfaction, co-worker satisfaction and the commitment to the organisation.

Another recent study by Akimoto *et al.* (2010) used a survey on office buildings and found that lower motivation to do work, higher perceived workload, and more negative emotions might indicate that productivity will be reduced in an uncomfortable environment in real life.

Worker mobility can also be viewed in the context of not being tied to a particular location, but needing to travel and work in a range of settings, both formal and informal. The impact of mobility on productivity is not an area that has been studied extensively, but it is assumed that lost time in commuting would lead to lower output, albeit partly offset by relevant mobile technologies.

2.7 Workplace Ecology

In this thesis, the impact of workplace ecology on the performance of employees is examined by testing a method in which office workplace ecosystems are evaluated using continuous process improvement. The study of workplace ecology helped in suggesting methods and testing their application in the workplace, allowing the determination of areas that could be

improved and also the examination and rating of overall workplace performance. In this section, the concept of workplace ecology in organisations is examined by considering relevant studies carried out in the past.

2.7.1 Organisation Ecology

Organisational ecology (OE) is the study of "life" within an organisational setting. It is a conceptual and empirical approach in the field of social sciences that is an important part of organisational studies. Organisational demography and population ecology of organisations are also terms used to refer to OE. In this field of study, information from economics, biology and sociology are also used along with statistical analysis so that the conditions suitable for the emergence, growth and downfall of organisations can be determined (Bakiev, 2012).

Baum & Amburgey (2002) state that the goal of organisational ecology is to describe the way economic, social and political conditions influence the relative abundance and diversity of organisations and to explain the changes in their structure as time progresses (Abbott *et al.,* 2013). Organisational ecology concentrates on examining organisational diversity and studying how social conditions have an impact on (a) the rate at which new organisational structures and new organisations are developed; (b) the rate at which organisations and organisational structures expire, and (c) the rate at which there are modifications to organisational structures. OE basically focuses on the evolutionary dynamics of processes that have an impact on organisational diversity. It examines selection processes, which is contradictory to the prevalence of adaptation in organisational studies (Singh & Lumsden, 1990).

It is presumed in the organisational ecology approach that the environment chooses organisations – i.e. those organisations that are closely attuned to the environmental conditions survive, while those that are a misfit are unable to survive. Those organisations that are highly reliable and accountable are selected by the environment (Oertel & Walgenbach, 2009) and both of these qualities are necessary for their survival (Hannan & Freeman, 1984; Oertel, & Walgenbach, 2009). Reliability is an organisation's ability to provide consistent services in terms of quality and accuracy. Because of the uncertainty in future conditions, investors and clients mostly stress reliability to a higher degree

compared to other factors like efficiency. Accountability is the organisation's ability to make logical arguments and show responsibility for the activities it is involved in (Carroll & Hannan, 2000; Oertel & Walgenbach, 2009). It is imperative, in this regard, to have an organisational structure that can be reproduced (Hannan & Freeman, 1984), for instance, its schedules and processes (Oertel, & Walgenbach, 2009).

2.7.2 Space

Companies that are seeking a competitive advantage in the present-day market need to make optimal use of their office space as office space incurs the highest expenses for an organisation after labour (Carroll & Hannan, 2000; Andrew *et al.,* 2008). It has been asserted by Vischer (1995) that companies are seeking a decrease in occupancy costs and for this they are carefully evaluating the way they utilise space. Companies have faced costly inefficiencies in space planning and building utilisation due to misunderstandings about the way accommodation impacts organisations. Companies that are able to decrease floor space get a two-stage opportunity to bring enhancements to their operations. Firstly, having appropriate sizing and redesigning can provide a better match between workspace design and user tasks; employees' workspace can support work performance more effectively and enhance efficiency. Secondly, reducing space provides organisations an opportunity to start a corporate change at a larger scale in companies that want to decrease overhead, empower employees and restructure work procedures. Bank of Boston is one such company that has managed to benefit from this right-sizing workspace opportunity (Andrew *et al.,* 2008).

It has been asserted by Andrew *et al.* (2008) that office space has a huge impact on the performance and efficiency of individuals. Various sources were cited by these researchers, e.g. Damian (2004); Heerwagen *et al.* (2004); Sundstrom *et al.* (1994); Vischer (2005), regarding their views on the effect of certain office environment aspects (such as light, noise, air quality) on worker efficiency. It was reported by Damian (2004) that just improvements in air quality could bring about a 15 per cent increase in productivity. According to Schneider (2007), better-designed office settings can improve organisational productive by as much as 21 per cent. However, despite these statistics, 46 per cent of the respondents were of the view that their company did not pay

much attention to developing a productive workplace. According to Mawson (2002), the increasing importance of the knowledge base of the economy is making it more difficult to determine worker efficiency and so the latter is not taken into account when creating the design for new office space.

The factors that have an impact on workplace productivity were critically examined by Clements-Croome (2000) who then provided recommendations on how the work environment could be made more conducive to productivity. Two significant design factors of productivity and satisfaction were analysed by Brill & Wiedemann (2001): workplace free of distractions, and opportunities for interactions full of informal learning. New facility design ideas were suggested by these authors in order to enhance the productivity and satisfaction of employees and improve their learning (Andrew *et al.,* 2008).

POE surveys of employees were used in various studies, like the one by Bottom *et al.* (1997). A longitudinal study was conducted by Brennan *et al.* (2002) in a large private company to find out how moving employees from traditional offices to open offices affected their performance. It was found that open office design was thought to bring about lesser productivity. However, the literature does not provide a clear agreement on this aspect. Vischer (1995) studied the way firms can decrease their occupancy costs by making more productive use of their office space.

2.7.3 Technology

Since the past few years, there has been considerable increase in the use of technology in workplaces. Firms use technology in various ways in order to save money, time and generally to ease out processes (Lai, 2011). One of the first technological advances was the automation of administrative tasks, which comprised the management of expense forms and the computerisation of employee work hours. This enables time saving with respect to collection, processing and distribution of information and even decreased the margin of error that occurred due to manual entry. Secondly, computer networks were utilised by firms so that company-wide information sharing was possible. This enabled quicker and more economical distribution of news and information in comparison to company meetings or printed announcements. Through technology, businesses were also able to react quickly to any market changes.

The need for filing and storing documents was reduced as electronic archives of data could be kept. Thirdly, technology could be used by businesses and management to share information sources. In this way, managers were able to access Internet-based schedules through which a meeting time that is suitable for all members of the working team could be selected (Bresnahan *et al.,* 2002; Autor *et al.,* 2003). Previously, one employee was supposed to contact each member separately regarding schedules, then finalise an appropriate meeting time and inform the team about it.

Quick and economical communication is another reason for use of technology. Irrespective of their location and with no high cost, workers were able to communicate in real time through the Internet. Whereas previously, long-distance phone calls, an administrative team, and teleconferences were required for co-ordination of resources in different offices. Lastly, documents could be edited or presentations could be shared between out-of-area workers by meeting online in Internet-based conference rooms (Aral *et al.,* 2007).

Lai (2011) stated that in recent years, the literature regarding the effect of technology on companies and other labour market outcomes has been increasing. Lai investigated how the allocation of decision rights between the managers and the workers can be affected by the use of database software and communication system in the organisation. However, the author used the longitudinal workplace-level data from the Canadian Workplace and Employee Survey (WES) that spanned from 1999 to 2006 and contained about 6,000 workplaces in each cross-section from different industries and provinces across Canada. Lai (2011) found when database software is used, the likelihood that workers obtain decision rights increases (by about 5.9%); but when communication software is used, the likelihood decreases (by about 4.8%). These results stand strong to alternative explanations that might affect the outcome variable, including an incentive system, human resources management practice and competition.

It has been observed from empirical studies in the literature that technology measured using variables like information and computer technology (ICT), number of workers using computers, or capital stock correspond with the implementation of new organisational structures (Caroli and Reenen, 2001; Bresnahan *et al.,* 2002) and also with the demand for skilled workers (Autor *et*

al., 2003). It was claimed by Garicano (2000) and Garicano & Rossi-Hansberg (2005) that hierarchical organisation structures would be impacted in various ways through different kinds of ICT. They specifically investigated two kinds of ICT: the cost of knowledge acquisition for the agents is reduced through one type of ICT, and the cost of communication in a firm is reduced through the other type. They indicated that the effects of the two types of ICT on the organisational structure are contrary to each other.

Empirically, a global firm-level data set was used by Bloom *et al.* (2009) through which it was observed that there was certainly a different impact of use of Enterprise Resource Planning system (through which cost of knowledge acquisition is reduced) and use of network and intranet (through which cost of communication is reduced) on the organisational structure. Thus, the various impacts of ICT are not clearly differentiated through aggregate measures of ICT, either at industrial level or at workplace level.

2.7.4 Concluding Remarks

Through what has been reviewed in the related literature pertaining to the research topic, the latter part of this chapter centred on the main research problem of workplace ecology assessment and the three related drivers of performance: organisation, space and technology. The previous sections are opportunities to reflect and summarise what might be drawn from these interwoven streams, what findings can be revealed and what further questions might be relevant for the overall research theme.

Workplace ecology is an area of promise for understanding how to improve levels of satisfaction, comfort and productivity in modern office settings. Building on traditional POE methods and the application of environmental auditing to physical workplaces, previous research findings as discussed in this chapter can be tested to form a more coherent and balanced work environment.

CHAPTER 3:
Conceptual Framework

This chapter conceptualises a new framework for integrating the key determinants of workplace ecology and develops a method to assess the performance of office workplace ecosystems. This chapter provides information on the research conceptual framework, and discusses the knowledge gap, the workplace ecology model, the idea of happiness, efficiency and empowerment, WEI and WPI, the continuous process improvement cycle, and the research propositions and hypotheses for testing.

This chapter discusses the knowledge gap (3.1), provides information about the research conceptual framework (3.2), summarises the notion of continuous process improvement cycle (3.3), and concludes with two research propositions and four hypotheses for testing (3.4).

3.1 Knowledge Gap

As mentioned earlier, an integral part of any organisation is its people. The workplace affects the productivity of people (Hoel *et al.,* 2011), thus affecting the business and financial performance of the organisation. However, there are many different strategies as to how organisations can improve the environment where people work, and make them more satisfied, comfortable and productive.

There is a gap in existing knowledge in relation to our understanding of the relationships between occupant satisfaction, comfort and productivity. Green buildings are often justified on financial grounds because they contribute to

creating happy, healthy workers with low levels of absenteeism, thus offsetting the commonly higher prices for their design and procurement. But the theory behind these types of assertions is weak and anecdotal.

It is well appreciated in the literature that buildings provide countless benefits to society, but they are also responsible for significant environmental and health impacts (Al-khawaja *et al.,* 2012). Buildings have a direct impact on occupants, affecting their general wellbeing. Previous studies do not show the relationship between the concepts of satisfaction, comfort and productivity that translate into happiness, efficiency and empowerment. No viable framework was found in the literature for evaluation and control of workplace ecology that enables integrated continuous process improvement in built environment settings. The proposed model is founded on the ELAP model, but presented in a way that is more amenable to quantitative assessment and analysis.

3.2 Conceptual Framework

The ELAP model (presented earlier in Figure 2.1) provides a great base to build a new more inclusive model capable of field testing and interrogation. The ELAP model has been defined as the first model that identifies three conceptually distinct but interrelated concepts from the underpinning literature regarding corporate environmental behaviour (e.g. environmental legitimacy, environmental accountability, and environmental proactivity). Also it is the first model that has shown how they can be integrated into a single framework.

The further development of this model took place over several years. The final iteration, as used in this study, is called the Work Ecology Model (WEM). The purpose of the model is to help address the knowledge gap discovered from the review of previous literature.

There are three key determinants that underpin the WEM model. Workplace ecology is a term that describes the conditions present in an office environment that are conducive to happiness, efficiency and empowerment of occupants. This research quantifies workplace ecology via a survey of staff at all levels in organisations for a range of different contexts, typologies and standards. Job complexity and a number of demographic variables are used to

explore relationships between the framework variables at the level of the individual. The framework supports correlations, if any, between satisfaction, comfort and productivity. Combining the three factors provides us with an indicator of workplace ecology, which is computed as an average for all occupants and helps identify possible areas of improvement. For example, if workplace ecology was low because comfort was low, and if productivity and comfort share a positive correlation, then investing in comfort improvements would lead to an increase in productivity that could be quantified and used as part of the business case for implementation. Furthermore, the collected data provides insight into the relative importance of the three variables and is influenced by the complexity of the job itself.

The framework presented in Figure 3.1 assists in enhancing both environmental performance and business performance by illustrating the interaction between the three key determinants. Workplace ecology needs an effective balance between them, and hence can be easily thwarted when even one of the determinants is underperforming. All three must be in harmony.

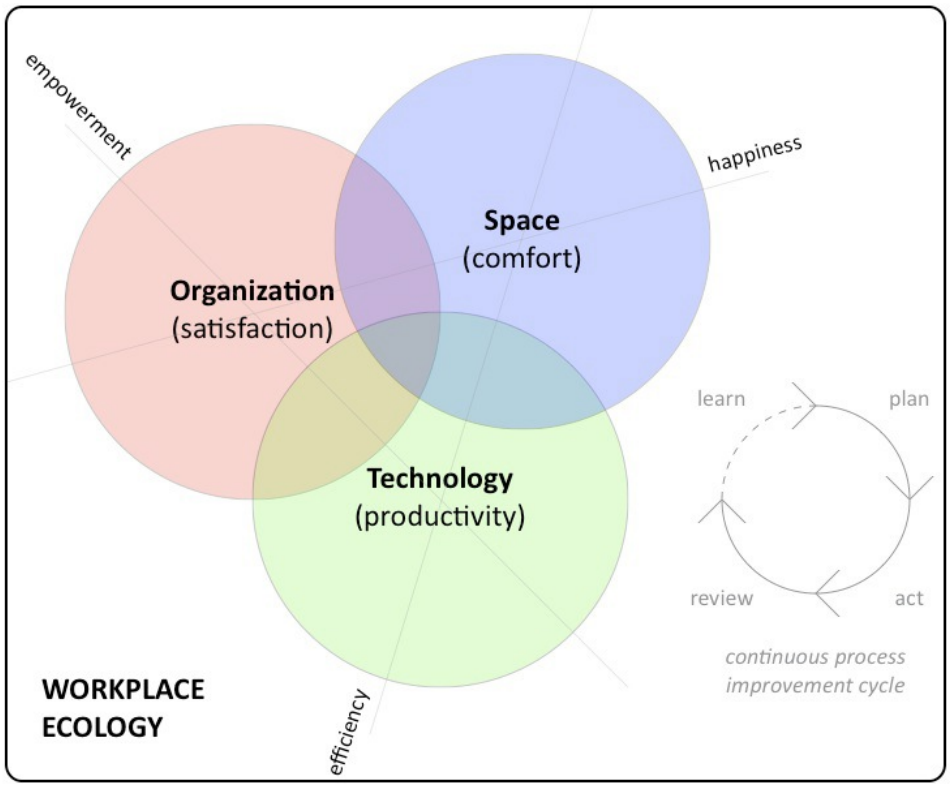

Figure 3. 1 Conceptual Framework for Workplace Ecology
Source: author

Happiness is conceptualised as the relationship between satisfaction (with the organisation) and comfort (with physical space), efficiency is conceptualised as the relationship between comfort and productivity (via technology provision), and empowerment is conceptualised as the relationship between satisfaction and productivity. The model acknowledges the need to plan, act, review and learn when making decisions about workplace ecology.

Logically, workplace ecology is a term that describes the conditions present in an office environment that are conducive to happiness, empowerment and efficiency of staff and comprise a mix of organisational satisfaction, spatial comfort and productive technologies. In each case a cycle of plan, act, review and learn is applied to provide opportunity for continuous and systematic improvement. Nevertheless, organisational satisfaction is related to human resource management and an individual's job, spatial comfort is related to facilities management and an individual's work environments, and productivity technology is related to information systems and an individual's ability to manage knowledge. Therefore organisation is interpreted in terms of satisfaction, space is interpreted in terms of comfort, and technology is interpreted in terms of productivity, all of which can be measured objectively. These reflect the three main cost centres for any orgnaisation.

The framework is tested via field surveys in various office settings in order to learn if the new model helps to deliver better outcomes for all stakeholders.

3.3 Continuous Process Improvement

Applying technically characterised ideas and management strategies is called continuous improvement (CI) and can avail the effectiveness of any activity over time. Total quality management (TQM) has also been quite useful for many organisations by achieving excellence and quality output. As CI identifies what improvements to make, it provides efficient ideas on how to achieve tasks more quickly (Zangwill & Kantor, 1998). TQM is an organized system integrated with people whose goal is to amplify the quality of work. On many aspects, CI greatly influences quality management and is the central standard of its existence (Deming, 1994; Evans & Lindsay, 2001; Temponi, 2005). The major components of CI processes are supplies, materials, equipment, people and producers. There exists room for improvement in every

step of the process of organisation, service and operation. A CI cycle was presented by Deming & Stewart (cited in Hanna & Newman, 2001). Many alternative models have evolved since the publishing of this work.

CI is actually a continuous cycle that is aimed to improve the quality and efficiency of the processes involved in any sector. In this research the WEM applies four steps in the cycle, which should be repeated in pursuit of continuous progress.

- *Plan*: Data is gathered for the identification and definition of issues or the problems that need amendments.
- *Act*: This annotates the process that involves the full-scale implementation of the plan.
- *Review*: It involves reflection on the implemented plan to understand its performance level.
- *Learn*: Often forgotten, this final step ensures that we learn from our actions and correctly influence new plans.

A major principle for continuous improvement is the establishment of constant self-assessment techniques. Self-assessment involves the evaluation of key systems, processes and outcomes by adopting an established framework and methodology. This creates a basis for the strategic and unceasing improvement in organisational performance (Stahl, 1998; Juran & Gryna, 1993). The outcome of this approach is the development of a strategy that ensures a proactive, measurable and realistic methodology to improve quality. For the measurement of manufacturing firms' productivity, a CI framework was developed. But later this framework received wide popularity in service organisations as well as academic institutions (Temponi, 2005).

The achievement of desired goals requires two main components: one is hard work and the other is buy-in from both the teams at the senior level and the teams at the building occupant level. In addition, if an enthusiastic team is hired it will also ensure success of the broader development process. Team and stakeholders keep check on report progress to see if their work is paying off and their money is invested in the right direction. It helps increase their motivation, engagement and interest for further business development. Meetings are also arranged to ensure the progress of team and project – it also

helps in identification of needs and determination of status (IFMA Foundation, 2010).

Argyris (1976; 2002) explained an approach related to CI called double loop learning, or lemniscates, which is a curve with a characteristic shape, consisting of two loops that meet at a central point as shown in Figure 3.2.

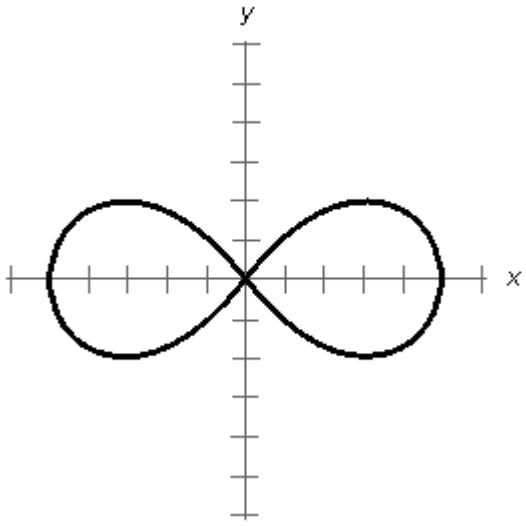

Figure 3. 2 Double-loop Learning
Source: Weisstein (2011)

An espoused theory of achievement based on single-loop learning is found to be the most general model of action. A double-loop learning model is projected as providing feedback and more effective decision-making. Double-loop learning involves not only adjusting one's actions, but also surfacing, challenging and adjusting the governing variables that are usually taken for granted. To fit double-loop learning into place, organisations should look beyond the familiar methods of approaching the challenge at hand to embrace novel and creative solutions (Argyris, 1976; 2002). Double-loop learning models add a powerful dimension to previous experiential learning cycles. In single loop learning models, learning was achieved through reflection on the success (or failure) of organisation actions (Argyris, 1976; 2002). However, in double-loop models, learning is understood through reflection on the validity and usefulness of organisation beliefs. This is considered a further development of CI in practice.

3.4 Research Propositions and Hypotheses

As previously stated, research has suggested that green buildings can provide improved comfort, productivity and health to occupants by ensuring that they receive more natural light as well as better air quality (Kats, 2003; Paul & Taylor, 2008; Ries *et al.,* 2006). A number of studies have suggested a connection between green buildings and work productivity. Previous studies have found an increase in productivity once the building where employees were working was updated to conform to greener standards (Heerwagen, 2000; Romm & Browning, 1998).

Identifying the main concepts of the WEM framework has led to the development of two research propositions, as follows:

- *RP #1 (Healthy Ecosystems):* At least three-quarters of the values for Workplace Ecology Index (WEI) and Workplace Performance Index (WPI) must fall within quadrant Q1 (see Figure 1.2 earlier) for a balanced work 'ecosystem'.
- *RP #2 (Ecosystem Attributes):* The components of Workplace Ecology Index (WEI) have a significant positive correlation with each other, moderated by job complexity.

Additionally, the correlation, if any, between each pair of the key variables in the model, identified in the literature as of interest to POE, needs to be explored. Based on insight from the WEM, four research hypotheses are formulated, as following:

- *Hypothesis H1:* Increases in workplace comfort lead to proportional increases in satisfaction.
- *Hypothesis H2:* Increases in workplace satisfaction lead to proportional increases in productivity.
- *Hypothesis H3:* Increases in workplace comfort lead to proportional increases in productivity.
- *Hypothesis H4:* The relationships between satisfaction, comfort and productivity are moderated by job complexity.

In the above hypotheses, the first component of the relationship is the *independent variable* (IV), while the second component of the relationship is

the *dependent variable* (DV). For example, in H1, it is hypothesised that increases in workplace comfort (IV) lead to proportional increases in satisfaction (DV). In H4, workplace comfort is the IV, productivity is the DV and satisfaction can be both. To test the model and the hypotheses, it is necessary to conduct a survey of building occupants in a range of different built environment settings. The names of the case studies have been kept confidential.

- 1 pilot study: Bond University Sustainable Development Building (Green Star 6 building)
- 1 recent Green Star 6 building (cool temperate climate)
- 1 older low quality non-green building (in need of refurbishment)
- 1 recent high quality non-green building (CBD location)
- 1 older medium quality non-green building (regional location)

The selection of case studies is a combination of granted access and fortunate negotiations. While many potential settings could be analysed, in the end permission was received only for a small cross-section of possible choices. The researcher is very appreciative to the organisations that agreed to cooperate in this study. In some cases, in order to encourage respondent participation, a donation of $5 was made to a charity of the organisation's choice for every valid survey completed. This donation was funded by Bond University.

The general model used in this study is described in Figure 3.3:

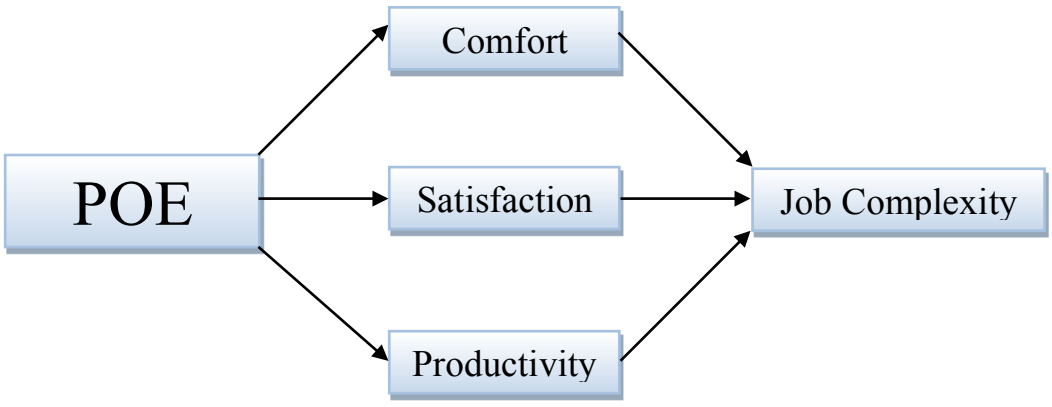

Figure 3. 3 General Questionnaire Model
Source: Author

In summary, the ELAP model (presented earlier in Figure 2.1) provides a robust base to build a new more inclusive model for this thesis capable of field testing and interrogation. Furthermore, the preceding chapters have identified, discussed, and integrated a number of components necessary for workplace ecology to guide organisations and researchers to realise their desired goals. The framework supports the research problem and the questions arising from the problem, and leads to the formation of hypotheses capable of testing. This chapter presents a conceptual framework for workplace ecology that supports collection and analysis of data via case studies as a method to assess the 'health' of office workplace ecosystems. The following chapter presents the research method adopted in this study.

CHAPTER 4:
Research Method

This chapter concerns the chosen research method and focuses on the rationale for questionnaire survey to collect data and the selection of case studies as demonstrators. This chapter provides information on the design of the questionnaire, the pilot study, the use of the SurveyMonkey™ online tool to collect data, ethics approval, and the method of hypothesis testing and validation to be used.

This chapter provides the method for this thesis and a description of the main research instrument (survey). Section 4.1 discusses the selection of method. Section 4.2 describes the pilot study to test the method and background information for the chosen case studies. Section 4.3 explores the survey methodology. Section 4.4 describes the questionnaire design. Section 4.5 provides explanation about the analysis strategy for collected data.

4.1 Selection of Method

Research method is the process used to collect information and data for the purpose of understanding the nature of research problems. However, there are two kinds of research methods available: qualitative and quantitative. Quantitative data collection usually involves numbers, graphs and charts, whereas, qualitative data collection methods deals with feelings and other non-quantifiable elements. Furthermore, qualitative research methods are defined as useful method for studies at the individual level and to find out, in depth, the ways in which people think or feel. On the other hand, quantitative research methods are defined as numerical data processing that can be put

into categories, or in rank order, or measured in recognised units, and include graphs and tables of raw data (Creswell & Punch, 2013).

The WEM requires specific data from workplace occupants in order to measure levels of satisfaction, comfort and productivity that link to organisation, space and technology respectively. Data is obtained via a POE process. There are a number of methods for collection of field data (such as observation, measurement, interview, focus groups and survey). In this study, as indeed is common for qualitative research, an online structured survey administered via SurveyMonkey™ is the preferred approach. Each workplace comprises a separate collection as each has unique characteristics that need to be identified.

The term 'survey' is used to explain the method of collecting data from a sample of individuals or groups. Surveys are useful for gathering data from a large sample (Dillman, 2000; Fowler, 2013) and are a relatively inexpensive data-collection method that can be easily distributed and administered.

A multiple case studies enable the WEM to be demonstrated and tested as being appropriate for different contexts. In a multiple case studies, the intention is to examine several cases displaying a range of characteristics to understand both the similarities and differences between the cases (Yin, 2013; Stake, 2013). Overall, the evidence created from this type of study is considered robust and reliable because it's designed to bring out the details from the viewpoint of the participants. This study utilises four case studies covering different building typologies, locations and quality standards. The names of the case studies have been kept confidential as requested from the HR departments involved.

The four case studies focus on factors of comfort (functional, psychological, and physical comfort), satisfaction (individual-level work satisfaction, environment, and job satisfaction), and productivity (information systems and an individual ability to manage knowledge). The purpose here is not to compare cases in order to show one type is better than another type, but rather to show the diversity of workplace ecology that might arise in different settings. The relationships between satisfaction, comfort and productivity are

tested in each case to see the extent of commonality that might exist, independent of context.

4.2 Pilot and Case Study Descriptions

Social scientists, in particular, have made wide use of case study qualitative research method to examine contemporary real-life situations and provide the basis for the application of ideas and extension of methods. Yin (1994) defined the case study research method as an empirical inquiry that investigates a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used.

The following pilot and case studies are used in this thesis (the identity of the case studies is to remain anonymous as requested by the stakeholders):

1 pilot study: Bond University Sustainable Development Building (Green Star 6 building)

The pilot study in this research is Bond University's School of Sustainable Development, an educational building located on the Gold Coast, Queensland, Australia. Sited in a sub-tropical region, this building has been designed to a standard of world's best practice with regard to environmental sustainability. The three-levels of building have central corridors on office floors with light wells and natural ventilation in order to maximise natural daylight and capture prevailing breezes. The orientation of the building gives a long east-west axis with protected north and south glazing. The construction comprises a lightweight façade with a concrete and steel frame. The building has 32 offices, two research rooms, three studios, one CAD/GIS room, and four meeting rooms, plus one 'Living Laboratory' and covered outdoor teaching and recreation spaces. In total there are more than 2,000 square metres of floor plate over three storeys. The building has been awarded a 6 star rating under the Green Star Education PILOT rating tool. This is the first educational project in Australia to be awarded a 6 star 'World Leadership' rating. The building was officially opened on the 11th August 2008. For the purpose of data collection the survey population is 35 staff.

1 recent Green Star 6 building (cool temperate climate) – Case Study # 1

The first case study represents a 5 star Australian Building Greenhouse Rating (ABGR) outcome and Green Star 6 rating, which is the highest rating awarded by the GBCA. The building is located in an Australian capital city and comprises about 35,000 square metres over 10 storeys and houses 900 government staff. The building is intended to set a benchmark in environmentally sustainable design, based on its innovative features such as promoting a healthy working environment, encourage improved business practices, help attract and retain staff and foster an environment for collaboration and innovation. Permission was obtained to survey one of the two main tenancies in the building, and for the purpose of data collection the survey population is 230 staff. However the services provided by this case study are designed to create a healthy environment by effectively regulating pollution, strive to deliver clean air, healthy waterways, safe land and minimal disturbances from noise and odour to the people. Additionally, the overall building received the following Green Building Council of Australia accreditation: 6-Star Office Design and 6-Star Office As-built. This case study is considered a leading example of environmental performance that strives to improve its own operations and activities. Furthermore, the case study's environmental policy is to commit continually to improving the environmental management and performance of their offices, laboratories and field-based operations.

1 older low quality non-green building (in need of refurbishment) – Case Study #2

The second case study building is a 20-level commercial office tower acquired in an Australian capital city. However, this case study provides services such as buying and managing business commercial properties and invites investors to participate in the wealth they generate. The building was acquired in 2001 and leased to five private sector tenants, one of which agreed to be surveyed. The property has been classified as a B-Grade building and comprises about 14,000 square metres of office space, with an average floor plate of 700 square metres. The building is serviced by six lifts. The floors have the flexibility to be subdivided and the higher levels in particular enjoy good natural light and views. The property sits on a flat rectangular shaped 1,834 square metre site

with entry reception and one retail shop on the ground floor, along with a side loading lane and entry to a three level basement car park accommodating up to 194 cars, which is necessary in an area with such strong demand. For the purpose of data collection the survey population is 64 staff. This case study is owned, occupied (in part) and managed by one of Australia's leading property investment and funds management organisations.

1 recent high quality non-green building (CBD location) – Case Study #3

The third case study building is an A-Grade modernism style high-rise building with concrete frame located within the central business district (CBD) of an Australian capital city. Its services aim to help people who, through circumstance, may be struggling financially, at risk of harm, or isolated. Being included within the broader community is a fundamental objective that this organisation considers necessary to build a better life for the community. The building comprises 11 floors above ground catering for a range of government tenancies. On each level, walkways lead from the lift foyer to the office areas. The building is serviced by six lifts located in the middle of the building. Level of quality and finish throughout the building is high. One of the tenancies agreed to participate in the survey. For the purpose of data collection the survey population is 44 staff. Core responsibilities range from building and maintaining public infrastructure, encouraging economic development, caring for the environment to looking after public health, recreation and cultural development.

1 older medium quality non-green building (regional location) – Case Study #4

The final case study provides infrastructure comprising roads, water, sewerage, community services and environmental protection to meet community expectations and demands. The building is a low-rise structure with a large centre atrium office space located in regional Australia. Its three storeys feature a dynamic central atrium space with a fully connected floor plan at all levels, designed for and used by a single owner-occupier. The atrium is a significant element of the design due to its aesthetic, open appearance. The building has been created not just to work in but to serve a large number of customers by providing a range of services and policies designed to support

vulnerable people and to help build resilient communities. For the purpose of data collection the survey population is 500 staff.

4.3 Survey Methodology

In order to conduct this study, ethics approval was required by Bond University Human Research Ethics Committee (BUHREC). Approval was received in 2012 to undertake data collection (Protocol Number R0-1468). The survey is crafted from a literature search of similar types of studies, although in this case it was important to keep the number of questions to a practical level to ensure participation rates remained acceptable (Purdey, 2010). The supervisory panel reviewed the original questionnaire and made some modifications before pre-testing began. The pre-test version was conducted via a paper survey for clarity and scale reliability given the small sample size. Based on feedback from this pilot, the wording of some questions was modified to improve understanding.

For the case studies, consent was first obtained from the organisation's HR department, who then circulated a specific SurveyMonkey™ URL link to staff at all levels of their organisation (i.e. directors, managers, professional staff, administrative staff). Each individual participant needed to also consent to participate, which was the first question within the survey, before being allowed to proceed to the other questions. Data was stored anonymously so that the privacy of the respondents was guaranteed. Organisations were provided with a summary of the findings as a reward for participation.

A target was set for each case study to achieve a response rate (sample size divided by population) of at least 30%. This target was set in conjunction with the supervisory team and is based on experience with other survey research over many years in Australia. Ideally about 30 responses are also required to enable valid regression analysis to occur. Reminder e-mails were sent via organisation contacts to all respondents who had not completed the survey within two weeks.

4.4 Survey Questionnaire

The survey instrument is divided into three parts. However, as mentioned previously the three key determinants for this study are organisation, space

and technology that are interpreted, for the purposes of quantification, as satisfaction, comfort and productivity (respectively). Job complexity and a range of demographic variables such as age, salary and organisational experience have been added as moderators for WEM.

The first part is headed 'about me'. It contains eleven questions relating to demographic variables to be used later for statistical analysis. These variables comprise:

- age
- gender
- current role
- length of current employment
- workspace type
- time worked in this space
- building type
- education
- motivation for study
- annual salary
- dominant work ethic

These questions are multiple choices based on a series of fixed answers.

The second part is headed 'about my job'. It contains ten questions related to satisfaction and ten questions related to job complexity. A response to each question is in the form of a five-point Likert scale. Each question is answered twice: the first relates to 'my opinion' (strongly disagree to strongly agree) and the second relates to 'relevance to me' (not important to very important). The difference between 'my opinion' and 'relevance to me' is that the former describes the level of agreement with the question posed while the latter describes whether the issue is influential to their work environment.

The third part is headed 'about my environment'. It contains ten questions relating to comfort and ten questions relating to productivity. A response to each question is again in the form of a five-point Likert scale. Each question is answered twice in terms of 'my opinion' and 'relevance to me' as described above.

Satisfaction levels are assessed using the following questions:

- *I love my job*
- *I get on well with those in higher positions*
- *I have a good relationship with my immediate work colleagues*
- *I receive generous rewards for my work*
- *I feel appreciated when I do good work*
- *Change in the workplace is generally handled openly*
- *I can easily speak with my supervisor/manager when I need to*
- *I feel engaged with the organisation and its mission*
- *Bullying and harassment in my workplace do not exist*
- *I have opportunities for advancement in the organisation*

Comfort levels are assessed using the following questions:

- *Office air temperature is normally conducive to my work tasks*
- *Indoor air quality/ventilation is excellent*
- *My work space has a good combination of natural and artificial light*
- *I have a clear view of what is going on outside the building*
- *Office noise disturbance is minimal*
- *I have control over my personal comfort settings*
- *I have reasonable visual privacy when working*
- *There are no work space issues that impact negatively on my health*
- *My office furniture is comfortable and adjustable*
- *I have appropriate work and storage space*

Productivity levels are assessed using the following questions:

- *I have access to the necessary IT services to fulfil my role*
- *All equipment I use in the office is provided by the organisation*
- *I can access the data I need wherever I might be*
- *My work is automatically backed up every day*
- *I use IT extensively to communicate and stay well informed*
- *Prompt IT support is available if I have a problem*
- *Data compatibility and transfer among office staff is straightforward*
- *If I need specialist IT equipment for a particular task it is provided*

- *I consider myself to be an effective user of technology*
- *Use of IT enables me to be more organised and professional*

Job complexity is assessed using the following questions:

- *My work tasks are usually undertaken collaboratively*
- *I regularly have to work extra hours*
- *I am an influential member of a dynamic team*
- *I often need to solve complex problems myself*
- *Effective time management is a critical attribute in my position*
- *I am responsible for the work of others in the organisation*
- *I am a person others frequently come to for help*
- *I spend a lot of time in formal and informal meetings*
- *I am allowed to work at home or offsite at my discretion*
- *I enjoy a job that is challenging albeit stressful at times*

Five-point Likert scales are the most popular for this type of survey (Khan & Kulkarni, 2013). In this research the five-point scale for 'your opinion' questions means -2 for strongly disagree, -1 for disagree, 0 for don't know, +1 for agree and +2 for strongly agree. In regard to 'relevance to me' questions, the five-point Likert scale means +1 for not important , +2 for slightly important, +3 for moderately important, +4 for quite important and +5 for very important.

Opportunity is provided to add any additional comments to further explain context or to provide feedback to the researcher. All in all, there are 93 questions to be answered. Progress through the survey is restricted if some questions are left unanswered.

The final survey instrument is included in Appendix 2.

4.5 Analysis Strategy

With regard to the analysis of data, initially a set of descriptive statistics are presented, which serve to profile the sample of respondents included in this study as well as to present an initial picture of the data collected (Ross, 2009). The descriptive statistics include all demographic variables, consisting of frequency tables in regard to categorical variables and measures of central

tendency and variability (such as the mean and standard deviation) in the case of continuous variables.

Next, reliability and factor analyses are conducted in order to determine whether the main set of survey questions, focusing on the issues of comfort, satisfaction and productivity, can be reduced from a larger number of items to a smaller number of factor scores for the purposes of the correlational and regressional analyses (Gravetter & Forzano, 2011; Kim & Mueller, 1988). If reliability is sufficiently high in replications, and if the factor analyses indicate that a smaller number of factor scores can adequately be utilised, factor scores are calculated for the 10 sub-topics included in the main portion of the survey for use in later analysis (Kim & Mueller, 1988).

A series of independent-samples t-tests are also computed in this study. These analyses serve to initially determine whether significant relationships exist for the main four variables included within this questionnaire. This specific type of analysis is appropriate as the focus is on the difference between two groups on a continuous measure (Urdan, 2010). With regard to these analyses, a noteworthy finding would indicate a significant difference between groups in regard to the dependent variable included in the analysis, while a non-significant finding would suggest that no significant difference exists between groups in regard to the dependent measure focused upon.

Finally, a series of regression analyses are conducted in which the main four variables consist of the dependent variables, while building type, along with a series of controls, constitute the independent variables included in the analyses. With regard to these regressions, the controls included in the analyses constitute the demographic variables included in the survey, which consist of the respondent's age, gender, level of education, and income. The purpose of including these variables in the regression analysis is to control for their effect, which presents the researcher with the specific effect of building type on the dependent variables after removing the effects of these demographic measures, if any (Siegel, 2011). These regression analyses have the benefit of including controls that cannot be done in the independent-samples t-tests. The results of the analyses, overall, serve to describe the data and sample collected, as well as to determine whether any significant

differences exist on the basis of building type in regard to comfort, satisfaction and productivity.

The first step is to determine whether these research variables (e.g. satisfaction, comfort, productivity and job complexity) are really independent. Specifically, it looks to see if all three could be caused by some (unmeasured) extrinsic construct (e.g. one of the demographic variables). In this regard, all the data sets are produced in Excel by creating new variable names for all of the demographic and related data, and these data are then imported one by one from the individual worksheets for each case into the summary worksheet. Following this, each of these individual data sets were converted into SPSS format. An SPSS syntax file is then constructed for these analyses, and consists of correlations, partial correlations, and regression analyses for Hypotheses 1-3 and RP#2. For Hypothesis 4, new centred interaction effects need to be calculated between comfort and complexity and between satisfaction and complexity, with a series of regression analyses then conducted. Additionally, for the demographics to be analysed, a series of syntax is required recoding, modifying, and labelling these measures. Following this, a series of one-way ANOVAs and t-tests are conducted on these measures. ANOVAs is a collection of statistical models used to analyse the differences among group means and their associated procedures. All of these analyses, modifications, etc. are included directly within the SPSS syntax file.

Additionally, a SEM path model is a family of statistical methods designed to test a conceptual or theoretical model and is conducted with AMOS, which is designed primarily for structural equation modelling, path analysis and covariance structure modelling, though it may be used to perform linear regression analysis and ANOVA and ANCOVA. No additional work needs to be done with respect to the data set, and essentially the new data set was specified within AMOS and a path model constructed using the tools within AMOS is specified for comfort to affect satisfaction and productivity, with satisfaction affecting productivity as well. Errors are also specified with the two endogenous variables (i.e. variables with arrows going into them). This model is then estimated in AMOS.

The data set is also specified within AMOS and a path model constructed specifying comfort to impact satisfaction and productivity, with satisfaction

impacting productivity as well. Errors are specified in relation to the two endogenous variables. This model was then estimated in AMOS. The purpose of this final model is to incorporate tests for Hypotheses 1-4 all within a single model and to test if three-quarters (75 per cent) of results for WEI and WPI fall within the Q1 quadrant model.

In summing up, this chapter introduced and discussed the research method adopted for this study and why it was chosen. The chapter has explained, in as much detail as possible, each of the case studies, and described the procedures used in designing the instrument, collecting the data. It also provided an explanation of the statistical procedures employed to analyse the data.

CHAPTER 5:
Data Analysis

This chapter comprises the analysis and interpretation of the collected data, including respondent demographics, descriptive statistics, the four-quadrant model test, regression analyses, and finally structured equation modelling (SEM).

Section 5.1 reports of questionnaire response rates. Section 5.2 summarises the data in terms of descriptive statistics across all case studies. Section 5.3 summarises the results of Case Study #1 in detail. This is then followed by Section 5.4 that summarises the results for Case Study #2 using the same structure, Section 5.5 that summarises the results for Case Study #3, and Section 5.6 that summarises the results for Case Study #4. Section 5.7 summarises the results for all the cases combined (i.e. full dataset). Then Section 5.8 gives additional analysis for the four-quadrant model test and finally Section 5.9 provides a discussion of the SEM model adopted in this thesis.

5.1 Response Rates

Data is collected via SurveyMonkey™ for each respondent and transferred to Excel spreadsheets to compute workplace performance according to the conceptual model. These summary sheets are provided in Appendix 3. Further statistical analysis is performed in SPSS and AMOS as described in the previous chapter.

With regard to response rates and sample size, the following results are reported and meet the targets prescribed earlier:

1) *Pilot:* 68.57% response rate with 30 responses
2) *Case Study #1:* 33.04% response rate with 76 responses
3) *Case Study #2:* 50.00% response rate with 32 responses
4) *Case Study #3:* 65.91% response rate with 29 responses
5) *Case Study #4:* 35.60% response rate with 178 responses
6) *Full Dataset:* 37.59% response rate with 315 responses

Attempts at surveying larger organisations did not bear fruit. Difficulties with the HR departments and securing permissions were very common (e.g. confirmation could not be obtained by the HR departments to survey staff), particularly where change management activities were underway.

5.2 Descriptive Statistics

Initially, a series of descriptive statistics are conducted on these data. The following table reports the results of these descriptive statistics on the continuous measures of interest, which consist of all scale measures, along with WEI, WPI and star rating.

Satisfaction, comfort and productivity are computed as the mean of their respective questions (opinion multiplied by relevance) and can be in the range -10 to +10. Happiness, efficiency and empowerment are computed as the mean of their respective components (e.g. happiness equals the mean of satisfaction and comfort). Complexity is computed as the mean of its respective questions (opinion multiplied by relevance), also in the range -10 to +10. Expectation uses a weighted approach to determine a score between 0 and 10 based on entered demographic data (a low score means low job status or expectation, while a high score means substantial responsibility or expectation). WEI equals the mean of happiness, efficiency and empowerment, while WPI equals expectation minus job complexity; both within the range -10 to +10. Star rating is computed on a scale of 0 to +5 based on the WEI.

The results are presented in Table 5.1.

Table 5. 1 Descriptive Statistics: Continuous Measures

Measure	Mean	Median	*SD*	Range	Min	Max
Full Dataset						
Satisfaction	0.864	0.800	3.103	17.800	-7.800	10.000
Comfort	-0.037	0.000	3.346	18.600	-9.200	9.400
Productivity	3.497	3.600	2.762	14.100	-4.100	10.000
Happiness	0.409	0.300	2.828	16.664	-6.961	9.703
Efficiency	1.778	1.715	2.612	16.409	-6.706	9.703
Empowerment	2.242	2.163	2.438	14.874	-4.874	10.000
Complexity	1.601	1.200	2.334	13.200	-4.200	9.000
Expectation	3.270	3.000	1.733	10.000	0.000	10.000
WEI	1.489	1.205	2.448	14.996	-5.193	9.803
WPI	1.669	1.800	2.256	16.600	-7.400	9.200
Star Rating	1.356	1.000	1.095	5.000	0.000	5.000
Case Study #1						
Satisfaction	0.713	1.000	2.854	13.500	-7.800	5.700
Comfort	-0.657	-0.450	3.621	18.100	-9.100	9.000
Productivity	3.186	3.350	2.528	11.600	-2.600	9.000
Happiness	0.001	0.348	2.888	13.821	-6.450	7.371
Efficiency	1.285	1.154	2.672	14.112	-5.112	9.000
Empowerment	1.974	2.137	2.354	12.246	-4.874	7.371
Complexity	1.924	1.700	2.469	11.600	-3.000	8.600
Expectation	3.184	3.000	1.267	6.000	0.500	6.500
WEI	1.090	0.932	2.492	12.878	-4.914	7.964
WPI	1.261	1.400	2.222	10.400	-4.200	6.200
Star rating	1.171	1.000	1.025	4.000	0.000	4.000
Case Study #2						
Satisfaction	2.594	2.200	3.306	14.400	-4.400	10.000
Comfort	0.484	0.450	3.208	12.100	-4.900	7.200
Productivity	3.425	3.600	3.189	13.500	-3.500	10.000
Happiness	1.608	0.820	2.879	10.670	-2.100	8.570
Efficiency	1.992	1.439	2.528	8.816	-1.563	7.253
Empowerment	3.059	3.335	2.935	12.236	-3.216	9.020
Complexity	2.050	1.700	2.902	13.000	-4.200	8.800
Expectation	3.297	3.000	2.514	10.000	0.000	10.000
WEI	2.237	1.899	2.616	10.038	-1.835	8.203
WPI	1.247	1.600	2.984	15.600	-6.400	9.200
Star Rating	1.594	1.000	1.388	5.000	0.000	5.000
Case Study #3						
Satisfaction	1.928	1.900	2.874	13.500	-3.500	10.000
Comfort	0.517	0.800	3.069	11.500	-4.600	6.900
Productivity	3.714	3.900	2.887	12.100	-2.100	10.000
Happiness	1.236	0.357	2.633	10.411	-2.100	8.311
Efficiency	2.155	1.774	2.561	8.627	-1.563	7.064
Empowerment	2.887	2.686	2.439	10.638	-2.254	8.384
Complexity	1.893	1.400	2.720	10.700	-1.700	9.000
Expectation	3.034	2.500	2.252	9.500	0.000	9.500
WEI	2.107	1.678	2.375	9.293	-1.542	7.751
WPI	1.141	1.000	1.989	9.200	-4.400	4.800

Star Rating	1.586	2.000	1.053	4.000	0.000	4.000
Case Study #4						
Satisfaction	0.445	0.250	3.082	17.000	-7.000	10.000
Comfort	0.044	0.050	3.277	18.600	-9.200	9.400
Productivity	3.607	3.600	2.768	14.100	-4.100	10.000
Happiness	0.232	0.238	2.763	16.664	-6.961	9.703
Efficiency	1.889	1.898	2.603	16.409	-6.706	9.703
Empowerment	2.104	1.896	2.347	13.290	-3.290	10.000
Complexity	1.335	1.000	2.066	11.500	-3.100	8.400
Expectation	3.340	3.000	1.649	8.000	0.500	8.500
WEI	1.425	1.053	2.383	14.996	-5.193	9.803
WPI	2.004	2.100	2.119	16.100	-7.400	8.700
Star Rating	1.354	2.000	1.065	5.000	0.000	5.000

The following tables summarise the results of the descriptive statistics conducted on the categorical measures of interest. These measures consist of respondent age, their current role, their primary workspace type, level of formal education, annual salary, location of the workspace, gender, their time spent employed in the organisation, time worked, their main motivation, and work ethic.

First, Table 5.2 presents these results for the full dataset, as well as separately for Case Study #2 and Case Study #3 datasets (the smaller sample sizes). Overall, respondents are generally middle-age, were most commonly employees, worked in open plan offices, had a diploma/certificate or bachelor's degree, made between $50,001 and $100,000 per year, worked in a non-green office building, were female, were employed in the organisation between one and 10 years, had worked for more than one year, indicated personal advancement as their main motivation, and as their work ethic, were either hard-working or reliable.

Table 5.3 additionally presents these results for Case Study #1 and Case Study #4 datasets (the two bigger sample sizes).

Table 5. 2 Descriptive Statistics of Categorical Variables (Part 1)

Measure	Full Dataset	Case Study #2	Case Study #3
Age			
Less than 25	23 (7.3%)	9 (28.1%)	3 (10.3%)
26-40	108 (34.3%)	12 (37.5%)	11 (37.9%)
41-55	141 (44.8%)	9 (28.1%)	8 (27.6%)
More than 55	43 (13.7%)	2 (6.3%)	7 (24.1%)
Current Role			
Contractor/Casual	27 (8.6%)	2 (6.3%)	
Employee	228 (72.4%)	22 (68.8%)	20 (69.0%)
Line Manager	42 (13.3%)	5 (15.6%)	5 (17.2%)
Senior Manager	18 (5.7%)	3 (9.4%)	4 (13.8%)
Primary Workspace Type			
Activity-based	1 (0.3%)		
Closed Cell Office	27 (8.6%)	8 (25.0%)	3 (10.3%)
Open Plan Office	229 (72.7%)	15 (46.9%)	21 (72.4%)
Shared Space	58 (18.4%)	9 (28.1%)	5 (17.2%)
Formal Education			
Diploma/Certificate	113 (35.9%)	10 (31.3%)	9 (31.0%)
Bachelor's Degree	114 (36.2%)	15 (46.9%)	10 (34.5%)
Masters/Doctorate	28 (8.9%)	5 (15.6%)	2 (6.9%)
None of the above	60 (19.0%)	2 (6.3%)	8 (27.6%)
Annual Salary (Gross)			
Less than $50,000	30 (9.5%)	7 (21.9%)	6 (20.7%)
$50,001-$100,000	231 (73.3%)	16 (50.0%)	19 (65.5%)
$100,001-$150,000	36 (11.4%)	5 (15.6%)	2 (6.9%)
More than $150,000	18 (5.7%)	4 (12.5%)	2 (6.9%)
Location of Workspace			
High Performance Green	76 (24.1%)		
Heritage-listed			
Other Office Building	239 (75.9%)	32 (100.0%)	29 (100.0%)
Non-office Buildings			
Gender			
Female	201 (63.8%)	20 (62.5%)	22 (75.9%)
Male	114 (36.2%)	12 (37.5%)	7 (24.1%)
Employed in Organisation			
Less than One Year	28 (8.9%)	6 (18.8%)	1 (3.4%)
1-10 Years	209 (66.3%)	24 (75.0%)	23 (79.3%)
11-20 Years	53 (16.8%)	2 (6.3%)	3 (10.3%)
More than 20 Years	25 (7.9%)		2 (6.9%)

Time Worked			
Less than 1 Year	59 (18.7%)	7 (21.9%)	7 (24.1%)
More than 1 Year	256 (81.3%)	25 (78.1%)	22 (75.9%)
Main Motivation			
Mandatory Qualification	23 (7.3%)	2 (6.3%)	1 (3.4%)
Personal Advancement	177 (56.2%)	19 (59.4%)	16 (55.2%)
Promotion/Remuneration	42 (13.3%)	7 (21.9%)	4 (13.8%)
NA/Other	73 (23.2%)	4 (12.5%)	8 (27.6%)
Work Ethic			
Creative Flair	13 (4.1%)		1 (3.4%)
Hard-Working	155 (49.2%)	19 (59.4%)	12 (41.4%)
Reliable	101 (32.1%)	11 (34.4%)	12 (41.4%)
Team Player	46 (14.6%)	2 (6.3%)	4 (13.8%)

Table 5. 3 Descriptive Statistics of Categorical Variables (Part 2)

Measure	Case Study #1	Case Study #4
Age		
Less than 25	1 (1.3%)	10 (5.6%)
26-40	34 (44.7%)	51 (28.7%)
41-55	30 (39.5%)	94 (52.8%)
More than 55	11 (14.5%)	23 (12.9%)
Current Role		
Contractor/Casual	2 (2.6%)	23 (12.9%)
Employee	61 (80.3%)	125 (70.2%)
Line Manager	10 (13.2%)	22 (12.4%)
Senior Manager	3 (3.9%)	8 (4.5%)
Primary Workspace Type		
Activity-based		1 (0.6%)
Closed Cell Office	1 (1.3%)	15 (8.4%)
Open Plan Office	72 (94.7%)	121 (68.0%)
Shared Space	3 (3.9%)	41 (23.0%)
Formal Education		
Diploma/Certificate	17 (22.4%)	77 (43.3%)
Bachelor's Degree	44 (57.9%)	45 (25.3%)
Masters/Doctorate	6 (7.9%)	15 (8.4%)
None of the above	9 (11.8%)	41 (23.0%)
Annual Salary (Gross)		
Less than $50,000	7 (9.2%)	10 (5.6%)
$50,001-$100,000	66 (86.8%)	130 (73.0%)
$100,001-$150,000	3 (3.9%)	26 (14.6%)
More than $150,000		12 (6.7%)
Location of Workspace		

High Performance Green	76 (100.0%)	
Heritage-listed		
Other Office Building		178 (100.0%)
Non-office Building		
Gender		
Female	41 (53.9%)	118 (66.3%)
Male	35 (46.1%)	60 (33.7%)
Employed in Organisation		
Less than One Year	9 (11.8%)	12 (6.7%)
1-10 Years	46 (60.5%)	116 (65.2%)
11-20 Years	16 (21.1%)	32 (18.0%)
More than 20 Years	5 (6.6%)	18 (10.1%)
Time Worked		
Less than 1 Year	10 (13.2%)	35 (19.7%)
More than 1 Year	66 (86.8%)	143 (80.3%)
Main Motivation		
Mandatory Qualification	7 (9.2%)	13 (7.3%)
Personal Advancement	45 (59.2%)	97 (54.5%)
Promotion/Remuneration	8 (10.5%)	23 (12.9%)
NA/Other	16 (21.1%)	45 (25.3%)
Work Ethic		
Creative Flair	4 (5.3%)	8 (4.5%)
Hard-Working	34 (44.7%)	90 (50.6%)
Reliable	25 (32.9%)	53 (29.8%)
Team Player	13 (17.1%)	27 (15.2%)

5.3 Results of Case Study #1

The first set of analyses focuses upon Pearson's correlations conducted between satisfaction, comfort, and productivity. The correlation conducted between satisfaction and comfort is found to be positive, strong, and statistically significant, $r(74) = .547$, $p < .001$. The correlation conducted between satisfaction and productivity is found to be positive, moderate in strength, and statistically significant, $r(74) = .460$, $p < .001$. Finally, the correlation conducted between comfort and productivity is also found to be positive, moderate in strength, and statistically significant, $r(74) = .449$, $p < .001$.

Next, a series of partial correlations are conducted controlling for the effect of complexity. First, the correlation conducted between satisfaction and comfort is found to be positive, strong, and statistically significant, $r(71) = .548$,

$p < .001$. The correlation between satisfaction and productivity is found to be positive, moderate in strength, and significant, $r(71) = .444$, $p < .001$, while the correlation between comfort and productivity is also positive, moderate, and significant, $r(71) = .446$, $p < .001$.

As shown in Table 5.4, in the initial regression analysis conducted, satisfaction is regressed upon comfort. Statistical significance is indicated here, with a one-unit increase in comfort being associated with a .431 unit increase in satisfaction. The second regression analysis regresses productivity upon satisfaction. Statistical significance is also indicated here, with a one unit increase in satisfaction being associated with a .407 unit increase in productivity. Following this, productivity is regressed upon comfort, with significance again being found. In this analysis, a one unit increase in comfort is found to be associated with a .314 unit increase in productivity. In the fourth linear regression analysis, satisfaction is regressed upon comfort, complexity, and the interaction between comfort and complexity. This analysis indicates statistical significance with regard to the main effect of comfort only. It is found that a one unit increase in comfort was associated with a .433 unit increase in satisfaction. The fifth regression model regresses productivity upon the main effects of satisfaction and complexity, along with the interaction between these two measures. The results of this analysis indicate significance with respect to the main effect of satisfaction as well as the interaction between satisfaction and complexity. Here, a one unit increase in satisfaction is found to be associated with a .485 unit increase in productivity, while the positive coefficient associated with the significant interaction effect indicates that the effect of satisfaction on productivity is stronger and more positive with higher levels of complexity. Finally, the sixth regression model regresses productivity upon comfort, complexity, as well as the interaction between these two measures. In this model, statistical significance is only indicated with respect to the main effect of comfort. Specifically, a one unit increase in comfort is found to be associated with a .303 unit increase in productivity. Additionally, all of these regression models are found to achieve statistical significance.

Table 5. 4 (Case Study # 1) Regression Analyses

Measure	*B*	*SE*	Beta	*t*	*p*	Tol.	VIF
Satisfaction							
(Constant)	.996	.280		3.554	.001		
Comfort	.431	.077	.547	5.625	.000	1.000	1.000
Productivity							
(Constant)	2.895	.267		10.831	.000		
Satisfaction	.407	.091	.460	4.453	.000	1.000	1.000
Productivity							
(Constant)	3.391	.265		12.794	.000		
Comfort	.314	.072	.449	4.326	.000	1.000	1.000
Satisfaction							
(Constant)	.622	.354		1.754	.084		
Comfort	.433	.077	.549	5.594	.000	.956	1.046
Complexity	.202	.112	.175	1.809	.075	.991	1.009
Comfort*Complexity	-.022	.033	-.067	-.683	.497	.957	1.045
Productivity							
(Constant)	2.673	.324		8.254	.000		
Satisfaction	.485	.096	.547	5.039	.000	.845	1.183
Complexity	-.007	.106	-.007	-.063	.950	.922	1.084
Satis.*Complexity	.121	.046	.281	2.635	.010	.875	1.142
Productivity							
(Constant)	3.153	.341		9.241	.000		
Comfort	.303	.075	.435	4.073	.000	.956	1.046
Complexity	.117	.107	.115	1.093	.278	.991	1.009
Comfort*Complexity	.011	.031	.038	.352	.726	.957	1.045

Note. [a]$F(1, 74) = 31.643$, $p < .001$; $R^2 = .300$; [b]$F(1, 74) = 19.826$, $p < .001$; $R^2 = .211$; [c]$F(1, 74) = 18.718$, $p < .001$; $R^2 = .202$; [d]$F(3, 72) = 12.136$, $p < .001$; $R^2 = .336$; [e]$F(3, 72) = 9.442$, $p < .001$; $R^2 = .282$; [f]$F(3, 72) = 6.601$, $p < .01$; $R^2 = .216$.

The following set of analyses conducted consists of difference in mean tests focusing upon the demographic and related measures included within this study. This current set of analyses are conducted on more of an exploratory basis in order to determine whether significant differences in these measures of interest exist on the basis of these workspace-related and similar variables.

First, Table 5.5 summarises the results of the ANOVAs conducted focusing upon respondent age. Within these analyses, age is included as a categorical variable, consisting of the following categories: less than 25, 26-40, 41-55, and more than 55. Here, significant mean differences are only indicated for expectation on the basis of respondent age. This result indicates significant mean differences in this measure on the basis of respondent age category, with no other significant differences found on the basis of age with regard to any of the remaining measures.

Table 5. 5 (Case Study # 1) ANOVAs by Age

Variable	Measure	Sum of Square	*df*	Mean Square	*F*	*p*
Satisfaction	Between Groups	20.885	3	6.962	.850	.471
	Within Groups	589.882	72	8.193		
	Total	610.767	75			
Comfort	Between Groups	62.134	3	20.711	1.619	.193
	Within Groups	921.332	72	12.796		
	Total	983.467	75			
Productivity	Between Groups	17.962	3	5.987	.935	.428
	Within Groups	461.192	72	6.405		
	Total	479.154	75			
Happiness	Between Groups	37.052	3	12.351	1.511	.219
	Within Groups	588.375	72	8.172		
	Total	625.426	75			
Efficiency	Between Groups	35.209	3	11.736	1.689	.177
	Within Groups	500.336	72	6.949		
	Total	535.544	75			
Empowerment	Between Groups	20.214	3	6.738	1.227	.306
	Within Groups	395.424	72	5.492		
	Total	415.638	75			
Complexity	Between Groups	7.618	3	2.539	.407	.749
	Within Groups	449.559	72	6.244		
	Total	457.177	75			
Expectation	Between Groups	21.927	3	7.309	5.343	.002
	Within Groups	98.494	72	1.368		
	Total	120.421	75			
WEI	Between Groups	30.172	3	10.057	1.662	.183
	Within Groups	435.596	72	6.050		
	Total	465.768	75			
WPI	Between Groups	19.567	3	6.522	1.338	.269
	Within Groups	350.894	72	4.874		
	Total	370.462	75			
Star Rating	Between Groups	6.303	3	2.101	2.087	.109
	Within Groups	72.474	72	1.007		
	Total	78.776	75			

Table 5.6 summarises the results of the ANOVAs conducted focusing upon current role. This measure incorporates the following categories of response: contractor/casual, employee, line manager, and senior manager. Among these analyses, significant mean differences are indicated in complexity and expectation on the basis of the respondent's current role.

Table 5. 6 (Case Study # 1) ANOVAs by Current Role

Variable	Measure	Sum of Square	*df*	Mean Square	*F*	*p*
Satisfaction	Between Groups	23.230	3	7.743	.949	.422
	Within Groups	587.537	72	8.160		
	Total	610.767	75			
Comfort	Between Groups	41.865	3	13.955	1.067	.369
	Within Groups	941.601	72	13.078		
	Total	983.467	75			
Productivity	Between Groups	12.789	3	4.263	.658	.580
	Within Groups	466.365	72	6.477		
	Total	479.154	75			
Happiness	Between Groups	24.743	3	8.248	.989	.403
	Within Groups	600.683	72	8.343		
	Total	625.426	75			
Efficiency	Between Groups	23.973	3	7.991	1.125	.345
	Within Groups	511.571	72	7.105		
	Total	535.544	75			
Empowerment	Between Groups	15.111	3	5.037	.905	.443
	Within Groups	400.526	72	5.563		
	Total	415.638	75			
Complexity	Between Groups	127.280	3	42.427	9.260	.000
	Within Groups	329.897	72	4.582		
	Total	457.177	75			
Expectation	Between Groups	54.279	3	18.093	19.695	.000
	Within Groups	66.142	72	.919		
	Total	120.421	75			
WEI	Between Groups	19.431	3	6.477	1.045	.378
	Within Groups	446.337	72	6.199		
	Total	465.768	75			
WPI	Between Groups	15.335	3	5.112	1.036	.382
	Within Groups	355.127	72	4.932		
	Total	370.462	75			
Star Rating	Between Groups	2.370	3	.790	.745	.529
	Within Groups	76.406	72	1.061		
	Total	78.776	75			

Table 5.7 summarises the results of the ANOVAs conducted with primary workspace type. This measure consists of the following categories of response: activity-based (mobile) closed cell office, open plan office (large group), and shared space (small group). Here, significant mean differences are indicated in complexity and WPI on the basis of workspace type.

Table 5. 7 (Case Study # 1) ANOVAs by Primary Workspace Type

Variable	Measure	Sum of Square	*df*	Mean Square	*F*	*p*
Satisfaction	Between Groups	11.520	2	5.760	.702	.499
	Within Groups	599.247	73	8.209		
	Total	610.767	75			
Comfort	Between Groups	11.582	2	5.791	.435	.649
	Within Groups	971.884	73	13.313		
	Total	983.467	75			
Productivity	Between Groups	10.454	2	5.227	.814	.447
	Within Groups	468.700	73	6.421		
	Total	479.154	75			
Happiness	Between Groups	10.963	2	5.482	.651	.524
	Within Groups	614.463	73	8.417		
	Total	625.426	75			
Efficiency	Between Groups	8.120	2	4.060	.562	.573
	Within Groups	527.425	73	7.225		
	Total	535.544	75			
Empowerment	Between Groups	9.318	2	4.659	.837	.437
	Within Groups	406.319	73	5.566		
	Total	415.638	75			
Complexity	Between Groups	65.256	2	32.628	6.077	.004
	Within Groups	391.922	73	5.369		
	Total	457.177	75			
Expectation	Between Groups	6.175	2	3.087	1.973	.146
	Within Groups	114.247	73	1.565		
	Total	120.421	75			
WEI	Between Groups	9.204	2	4.602	.736	.483
	Within Groups	456.564	73	6.254		
	Total	465.768	75			
WPI	Between Groups	34.385	2	17.193	3.734	.029
	Within Groups	336.077	73	4.604		
	Total	370.462	75			
Star Rating	Between Groups	.790	2	.395	.370	.692
	Within Groups	77.986	73	1.068		
	Total	78.776	75			

Table 5.8 summarises the results of the ANOVAs conducted with the level of formal education reported by respondents. This measure contains the responses of Diploma/Certificate, Bachelors degree, and Masters/Doctorate, as well as a "none of the above" category of response. In these analyses, significant differences in complexity and expectation are indicated on the basis of the respondent's level of formal education.

Table 5. 8 (Case Study # 1) ANOVAs by Formal Education

Variable	Measure	Sum of Square	*df*	Mean Square	*F*	*p*
Satisfaction	Between Groups	9.751	3	3.250	.389	.761
	Within Groups	601.016	72	8.347		
	Total	610.767	75			
Comfort	Between Groups	17.342	3	5.781	.431	.732
	Within Groups	966.125	72	13.418		
	Total	983.467	75			
Productivity	Between Groups	23.570	3	7.857	1.242	.301
	Within Groups	455.584	72	6.328		
	Total	479.154	75			
Happiness	Between Groups	9.038	3	3.013	.352	.788
	Within Groups	616.389	72	8.561		
	Total	625.426	75			
Efficiency	Between Groups	15.680	3	5.227	.724	.541
	Within Groups	519.864	72	7.220		
	Total	535.544	75			
Empowerment	Between Groups	11.332	3	3.777	.673	.572
	Within Groups	404.306	72	5.615		
	Total	415.638	75			
Complexity	Between Groups	57.616	3	19.205	3.461	.021
	Within Groups	399.562	72	5.549		
	Total	457.177	75			
Expectation	Between Groups	25.437	3	8.479	6.427	.001
	Within Groups	94.984	72	1.319		
	Total	120.421	75			
WEI	Between Groups	9.699	3	3.233	.510	.676
	Within Groups	456.069	72	6.334		
	Total	465.768	75			
WPI	Between Groups	21.862	3	7.287	1.505	.221
	Within Groups	348.600	72	4.842		
	Total	370.462	75			
Star Rating	Between Groups	1.343	3	.448	.416	.742
	Within Groups	77.434	72	1.075		
	Total	78.776	75			

The respondent's annual salary is also analysed, with Table 5.9 summarising the results of the ANOVAs conducted with this measure. As the categories of response, this measure incorporates the following: less than $50,000 gross, $50,001-$100,000 gross, $100,001-$150,000 gross, and more than $150,000 gross. Here, significant mean differences are again indicated with regard to complexity and expectation on the basis of annual salary.

Table 5. 9 (Case Study # 1) ANOVAs by Annual Salary

Variable	Measure	Sum of Square	*df*	Mean Square	*F*	*p*
Satisfaction	Between Groups	14.454	2	7.227	.885	.417
	Within Groups	596.312	73	8.169		
	Total	610.767	75			
Comfort	Between Groups	23.899	2	11.950	.909	.407
	Within Groups	959.567	73	13.145		
	Total	983.467	75			
Productivity	Between Groups	10.567	2	5.283	.823	.443
	Within Groups	468.587	73	6.419		
	Total	479.154	75			
Happiness	Between Groups	8.594	2	4.297	.509	.603
	Within Groups	616.832	73	8.450		
	Total	625.426	75			
Efficiency	Between Groups	16.870	2	8.435	1.187	.311
	Within Groups	518.674	73	7.105		
	Total	535.544	75			
Empowerment	Between Groups	12.129	2	6.065	1.097	.339
	Within Groups	403.508	73	5.528		
	Total	415.638	75			
Complexity	Between Groups	51.246	2	25.623	4.608	.013
	Within Groups	405.932	73	5.561		
	Total	457.177	75			
Expectation	Between Groups	38.629	2	19.315	17.239	.000
	Within Groups	81.792	73	1.120		
	Total	120.421	75			
WEI	Between Groups	10.396	2	5.198	.833	.439
	Within Groups	455.372	73	6.238		
	Total	465.768	75			
WPI	Between Groups	1.005	2	.503	.099	.906
	Within Groups	369.457	73	5.061		
	Total	370.462	75			
Star Rating	Between Groups	.813	2	.407	.381	.685
	Within Groups	77.963	73	1.068		
	Total	78.776	75			

Next, a series of independent-samples t-tests are conducted on the basis of respondent gender. As shown in Table 5.10, no significant mean differences in these measures are indicated on the basis of respondent gender using this sample of data.

Table 5. 10 (Case Study #1) Independent-Samples t-Test by Gender

Variable	*F*	*p*	*t*	*df*	*p*	Mean Diff.
Satisfaction	1.895	.173	-.364	74	.717	-0.240
Comfort	2.477	.120	-.906	74	.368	-0.756
Productivity	.119	.731	-.426	74	.671	-0.249
Happiness	2.396	.126	-.720	74	.474	-0.480
Efficiency	1.294	.259	-.882	74	.381	-0.543
Empowerment	1.519	.222	-.483	74	.630	-0.263
Complexity	.002	.966	.067	74	.946	0.039
Expectation	1.627	.206	-.825	74	.412	-0.241
WEI	1.024	.315	-.758	74	.451	-0.436
WPI	.357	.552	-.544	74	.588	-0.280
Star Rating	.049	.825	-.450	74	.654	-0.107

Table 5.11 summarises the results of the ANOVAs conducted with the respondent's employment in the organisation. This measure is categorised in the following way: less than one year of employment, 1-10 years, 11-20 years, and more than 20 years of employment. As shown, significant mean differences are found with respect to all measures.

Table 5. 11 (Case Study #1) ANOVAs by Employed in Organisation

Variable	Measure	Sum of Square	*df*	Mean Square	*F*	*p*
Satisfaction	Between Groups	82.577	3	27.526	3.752	.015
	Within Groups	528.190	72	7.336		
	Total	610.767	75			
Comfort	Between Groups	116.818	3	38.939	3.235	.027
	Within Groups	866.649	72	12.037		
	Total	983.467	75			
Productivity	Between Groups	52.431	3	17.477	2.949	.038
	Within Groups	426.723	72	5.927		
	Total	479.154	75			
Happiness	Between Groups	96.930	3	32.310	4.402	.007
	Within Groups	528.497	72	7.340		
	Total	625.426	75			
Efficiency	Between Groups	69.243	3	23.081	3.564	.018
	Within Groups	466.301	72	6.476		
	Total	535.544	75			
Empowerment	Between Groups	44.519	3	14.840	2.879	.042
	Within Groups	371.119	72	5.154		
	Total	415.638	75			
Complexity	Between Groups	63.551	3	21.184	3.875	.013
	Within Groups	393.626	72	5.467		
	Total	457.177	75			
Expectation	Between Groups	16.135	3	5.378	3.713	.015
	Within Groups	104.286	72	1.448		
	Total	120.421	75			
WEI	Between Groups	65.535	3	21.845	3.930	.012
	Within Groups	400.233	72	5.559		
	Total	465.768	75			
WPI	Between Groups	54.412	3	18.137	4.132	.009
	Within Groups	316.050	72	4.390		
	Total	370.462	75			
Star Rating	Between Groups	16.079	3	5.360	6.155	.001
	Within Groups	62.698	72	.871		
	Total	78.776	75			

A series of independent-samples t-tests are conducted focusing upon time worked. This measure is dichotomised as either less than one year or more than one year worked. As presented in Table 5.12, significant mean differences on the basis of time worked are found in satisfaction, complexity, and expectation.

Table 5. 12 (Case Study #1) Independent-Samples t-Test by Time Worked

Variable	*F*	*p*	*t*	*df*	*p*	Mean Diff.
Satisfaction	1.590	.211	2.373	74	.020	2.230
Comfort	.826	.366	1.373	74	.174	1.677
Productivity	1.541	.218	.340	74	.735	0.293
Happiness	2.092	.152	1.988	74	.050	1.911
Efficiency	4.661	.034	1.865	27	.073	0.964
Empowerment	2.381	.127	1.657	74	.102	1.309
Complexity	.679	.413	-2.370	74	.020	-1.927
Expectation	.035	.852	-2.445	74	.017	-1.018
WEI	3.709	.058	1.666	74	.100	1.393
WPI	1.623	.207	1.209	74	.230	0.909
Star Rating	2.596	.111	1.776	74	.080	0.609

Table 5.13 summarises the results of the ANOVAs conducted with main motivation. This measure is categorised as mandatory qualification, personal advancement, promotion/remuneration, and not applicable/other. Among these analyses, significant mean differences were found with respect to happiness and expectation.

Table 5. 13 (Case Study #1) ANOVAs by Main Motivation

Variable	Measure	Sum of Square	*df*	Mean Square	*F*	*p*
Satisfaction	Between Groups	43.613	3	14.538	1.846	.147
	Within Groups	567.154	72	7.877		
	Total	610.767	75			
Comfort	Between Groups	91.209	3	30.403	2.453	.070
	Within Groups	892.258	72	12.392		
	Total	983.467	75			
Productivity	Between Groups	10.642	3	3.547	.545	.653
	Within Groups	468.512	72	6.507		
	Total	479.154	75			
Happiness	Between Groups	64.460	3	21.487	2.758	.048
	Within Groups	560.966	72	7.791		
	Total	625.426	75			
Efficiency	Between Groups	38.512	3	12.837	1.860	.144
	Within Groups	497.032	72	6.903		
	Total	535.544	75			
Empowerment	Between Groups	22.853	3	7.618	1.396	.251
	Within Groups	392.784	72	5.455		
	Total	415.638	75			
Complexity	Between Groups	4.252	3	1.417	.225	.879
	Within Groups	452.926	72	6.291		
	Total	457.177	75			
Expectation	Between Groups	22.442	3	7.481	5.497	.002
	Within Groups	97.979	72	1.361		
	Total	120.421	75			
WEI	Between Groups	39.998	3	13.333	2.255	.089
	Within Groups	425.770	72	5.913		
	Total	465.768	75			
WPI	Between Groups	21.615	3	7.205	1.487	.225
	Within Groups	348.847	72	4.845		
	Total	370.462	75			
Star Rating	Between Groups	5.543	3	1.848	1.816	.152
	Within Groups	73.234	72	1.017		
	Total	78.776	75			

Finally, Table 5.14 summarises the results of the ANOVAs conducted with respondent work ethic. The following categories of response are incorporated into this measure: creative flair, hard-working, reliable, and team player. These results indicate significant mean differences in expectation and WPI on the basis of work ethic.

Table 5. 14 (Case Study #1) ANOVAs by Work Ethic

Variable	Measure	Sum of Square	*df*	Mean Square	*F*	*p*
Satisfaction	Between Groups	19.642	3	6.547	.797	.499
	Within Groups	591.125	72	8.210		
	Total	610.767	75			
Comfort	Between Groups	6.316	3	2.105	.155	.926
	Within Groups	977.150	72	13.572		
	Total	983.467	75			
Productivity	Between Groups	9.206	3	3.069	.470	.704
	Within Groups	469.948	72	6.527		
	Total	479.154	75			
Happiness	Between Groups	1.489	3	.496	.057	.982
	Within Groups	623.938	72	8.666		
	Total	625.426	75			
Efficiency	Between Groups	2.882	3	.961	.130	.942
	Within Groups	532.662	72	7.398		
	Total	535.544	75			
Empowerment	Between Groups	6.144	3	2.048	.360	.782
	Within Groups	409.493	72	5.687		
	Total	415.638	75			
Complexity	Between Groups	42.530	3	14.177	2.462	.069
	Within Groups	414.648	72	5.759		
	Total	457.177	75			
Expectation	Between Groups	27.534	3	9.178	7.114	.000
	Within Groups	92.887	72	1.290		
	Total	120.421	75			
WEI	Between Groups	.966	3	.322	.050	.985
	Within Groups	464.802	72	6.456		
	Total	465.768	75			
WPI	Between Groups	57.110	3	19.037	4.374	.007
	Within Groups	313.351	72	4.352		
	Total	370.462	75			
Star Rating	Between Groups	.929	3	.310	.287	.835
	Within Groups	77.847	72	1.081		
	Total	78.776	75			

5.4 Results of Case Study #2

The same sets of analyses are conducted, as before, using a series of Pearson's correlations between satisfaction, comfort, and productivity. First, a positive, borderline strong and statistically significant correlation is found between

satisfaction and comfort, r(30) = .492, p < .01. Next, a statistically significant, strong, and positive correlation is found between satisfaction and productivity, r(30) = .583, p < .001. Finally, a positive, weak, and non-significant correlation is indicated between comfort and productivity, r(30) = .184, p = .312.The second set of analyses consist of partial correlations that controlled for the effect of complexity. First, the correlation between satisfaction and comfort is found to be non-significant, r(27) = .300, p = .102, while the correlation between satisfaction and productivity is found to be positive, statistically significant, and approximately strong, r(27) = .480, p < .01. Additionally, the correlation between comfort and productivity is found to be negative, weak, and failed to achieve statistical significance, r(27) = -.098, p = .601. These results indicated that complexity serves as a moderately important moderator with respect to these correlations.

As shown in Table 5.15, the first analysis regresses satisfaction upon comfort. Here, statistical significance is indicated, with a one unit increase in comfort being associated with a .507 unit increase in satisfaction. The second linear regression analysis regressed productivity on satisfaction. Here, statistical significance is also indicated, with a one unit increase in satisfaction being associated with a .563 unit increase in productivity. In the third linear regression, productivity is regressed upon comfort, with significance not being found here. The following linear regression regresses satisfaction upon comfort, complexity, as well as the interaction between these two measures. No statistically significant results are found in this analysis. Following this, productivity is regressed upon satisfaction, complexity, and the interaction between these two measures. This analysis finds significance with respect to the effect of satisfaction, with a one unit increase in satisfaction being associated with a .531 unit increase in productivity. In the final linear regression analysis conducted, productivity is regressed upon comfort, complexity, as well as the interaction between these two measures. No significant results are found in this analysis. Additionally, all regression models with the exception of the third model are found to achieve statistical significance.

Table 5. 15 (Case Study #2) Regression Analyses

Measure	*B*	*SE*	Beta	*t*	*p*	Tol.	VIF
Satisfaction							
(Constant)	2.348	.523		4.488	.000		
Comfort	.507	.164	.492	3.095	.004	1.000	1.000
Productivity							
(Constant)	1.966	.595		3.303	.002		
Satisfaction	.563	.143	.583	3.932	.000	1.000	1.000
Productivity							
(Constant)	3.336	.570		5.855	.000		
Comfort	.183	.178	.184	1.028	.312	1.000	1.000
Satisfaction							
(Constant)	1.725	.674		2.560	.016		
Comfort	.311	.211	.302	1.473	.152	.598	1.672
Complexity	.247	.255	.217	.969	.341	.502	1.994
Comfort*Complexity	.038	.074	.110	.514	.611	.547	1.828
Productivity							
(Constant)	1.649	.647		2.548	.017		
Satisfaction	.531	.188	.550	2.825	.009	.584	1.712
Complexity	.274	.207	.249	1.322	.197	.626	1.599
Satis.*Complexity	-.035	.058	-.132	-.612	.546	.477	2.096
Productivity							
(Constant)	2.164	.672		3.223	.003		
Comfort	-.191	.211	-.193	-.909	.371	.598	1.672
Complexity	.367	.254	.334	1.442	.160	.502	1.994
Comfort*Complexity	.109	.074	.325	1.468	.153	.547	1.828

Note. [a]$F(1, 30) = 9.579$, $p < .01$; $R^2 = .242$; [b]$F(1, 30) = 15.460$, $p < .001$; $R^2 = .340$; [c]$F(1, 30) = 1.056$, $p = .312$; $R^2 = .034$; [d]$F(3, 28) = 3.922$, $p < .05$; $R^2 = .296$; [e]$F(3, 28) = 5.693$, $p < .01$; $R^2 = .379$; [f]$F(3, 28) = 3.082$, $p < .05$; $R^2 = .248$.

The following series of analyses are conducted focusing upon the demographics and related measures included within this study. First, Table 5.16 summarises the results of the ANOVAs conducted with respondent age. Here, significant mean differences are found with respect to satisfaction, expectation and WPI on the basis of respondent age.

Table 5. 16 (Case Study #2) ANOVAs by Age

Variable	Measure	Sum of Square	*df*	Mean Square	*F*	*p*
Satisfaction	Between Groups	88.940	3	29.647	3.323	.034
	Within Groups	249.839	28	8.923		
	Total	338.779	31			
Comfort	Between Groups	45.617	3	15.206	1.557	.222
	Within Groups	273.385	28	9.764		
	Total	319.002	31			
Productivity	Between Groups	26.109	3	8.703	.843	.482
	Within Groups	289.091	28	10.325		
	Total	315.200	31			
Happiness	Between Groups	55.767	3	18.589	2.588	.073
	Within Groups	201.150	28	7.184		
	Total	256.916	31			
Efficiency	Between Groups	27.996	3	9.332	1.536	.227
	Within Groups	170.151	28	6.077		
	Total	198.147	31			
Empowerment	Between Groups	54.100	3	18.033	2.371	.092
	Within Groups	212.925	28	7.604		
	Total	267.026	31			
Complexity	Between Groups	15.804	3	5.268	.602	.619
	Within Groups	245.176	28	8.756		
	Total	260.980	31			
Expectation	Between Groups	75.131	3	25.044	5.805	.003
	Within Groups	120.799	28	4.314		
	Total	195.930	31			
WEI	Between Groups	43.569	3	14.523	2.413	.088
	Within Groups	168.523	28	6.019		
	Total	212.092	31			
WPI	Between Groups	75.908	3	25.303	3.541	.027
	Within Groups	200.052	28	7.145		
	Total	275.960	31			
Star Rating	Between Groups	12.108	3	4.036	2.373	.092
	Within Groups	47.611	28	1.700		
	Total	59.719	31			

Next, Table 5.17 summarises the results of the ANOVAs conducted with the respondents' current role. The results of these analyses find a significant mean difference in complexity as well as expectation on the basis of the respondents' current role.

Table 5. 17 (Case Study #2) ANOVAs by Current Role

Variable	Measure	Sum of Square	*df*	Mean Square	*F*	*p*
Satisfaction	Between Groups	5.862	3	1.954	.164	.919
	Within Groups	332.916	28	11.890		
	Total	338.779	31			
Comfort	Between Groups	46.484	3	15.495	1.592	.214
	Within Groups	272.518	28	9.733		
	Total	319.002	31			
Productivity	Between Groups	16.493	3	5.498	.515	.675
	Within Groups	298.707	28	10.668		
	Total	315.200	31			
Happiness	Between Groups	17.103	3	5.701	.666	.580
	Within Groups	239.813	28	8.565		
	Total	256.916	31			
Efficiency	Between Groups	15.490	3	5.163	.792	.509
	Within Groups	182.657	28	6.523		
	Total	198.147	31			
Empowerment	Between Groups	3.139	3	1.046	.111	.953
	Within Groups	263.886	28	9.425		
	Total	267.026	31			
Complexity	Between Groups	86.737	3	28.912	4.646	.009
	Within Groups	174.243	28	6.223		
	Total	260.980	31			
Expectation	Between Groups	141.812	3	47.271	24.457	.000
	Within Groups	54.118	28	1.933		
	Total	195.930	31			
WEI	Between Groups	8.293	3	2.764	.380	.768
	Within Groups	203.799	28	7.279		
	Total	212.092	31			
WPI	Between Groups	26.085	3	8.695	.974	.419
	Within Groups	249.875	28	8.924		
	Total	275.960	31			
Star Rating	Between Groups	2.219	3	.740	.360	.782
	Within Groups	57.500	28	2.054		
	Total	59.719	31			

With respect to the ANOVAs conducted with primary workspace, in Table 5.18, significant mean differences are indicated with respect to comfort, happiness and expectation on the basis of primary workspace.

Table 5. 18 (Case Study #2) ANOVAs by Primary Workspace Type

Variable	Measure	Sum of Square	*df*	Mean Square	*F*	*p*
Satisfaction	Between Groups	55.877	2	27.938	2.864	.073
	Within Groups	282.902	29	9.755		
	Total	338.779	31			
Comfort	Between Groups	124.026	2	62.013	9.224	.001
	Within Groups	194.976	29	6.723		
	Total	319.002	31			
Productivity	Between Groups	5.345	2	2.673	.250	.780
	Within Groups	309.855	29	10.685		
	Total	315.200	31			
Happiness	Between Groups	61.830	2	30.915	4.596	.018
	Within Groups	195.086	29	6.727		
	Total	256.916	31			
Efficiency	Between Groups	25.041	2	12.521	2.098	.141
	Within Groups	173.106	29	5.969		
	Total	198.147	31			
Empowerment	Between Groups	18.342	2	9.171	1.069	.356
	Within Groups	248.684	29	8.575		
	Total	267.026	31			
Complexity	Between Groups	37.025	2	18.513	2.397	.109
	Within Groups	223.955	29	7.723		
	Total	260.980	31			
Expectation	Between Groups	96.639	2	48.319	14.113	.000
	Within Groups	99.291	29	3.424		
	Total	195.930	31			
WEI	Between Groups	26.751	2	13.375	2.093	.142
	Within Groups	185.341	29	6.391		
	Total	212.092	31			
WPI	Between Groups	19.647	2	9.824	1.111	.343
	Within Groups	256.312	29	8.838		
	Total	275.960	31			
Star Rating	Between Groups	7.222	2	3.611	1.995	.154
	Within Groups	52.497	29	1.810		
	Total	59.719	31			

In Table 5.19, a series of ANOVAs are conducted focusing upon the respondents' formal education. These analyses do not find statistical significance in any case.

Table 5. 19 (Case Study #2) ANOVAs by Formal Education

Variable	Measure	Sum of Square	*df*	Mean Square	*F*	*p*
Satisfaction	Between Groups	1.565	3	.522	.043	.988
	Within Groups	337.213	28	12.043		
	Total	338.779	31			
Comfort	Between Groups	12.908	3	4.303	.394	.759
	Within Groups	306.094	28	10.932		
	Total	319.002	31			
Productivity	Between Groups	10.050	3	3.350	.307	.820
	Within Groups	305.150	28	10.898		
	Total	315.200	31			
Happiness	Between Groups	3.853	3	1.284	.142	.934
	Within Groups	253.063	28	9.038		
	Total	256.916	31			
Efficiency	Between Groups	3.107	3	1.036	.149	.930
	Within Groups	195.041	28	6.966		
	Total	198.147	31			
Empowerment	Between Groups	4.464	3	1.488	.159	.923
	Within Groups	262.562	28	9.377		
	Total	267.026	31			
Complexity	Between Groups	31.425	3	10.475	1.278	.301
	Within Groups	229.555	28	8.198		
	Total	260.980	31			
Expectation	Between Groups	42.830	3	14.277	2.611	.071
	Within Groups	153.100	28	5.468		
	Total	195.930	31			
WEI	Between Groups	2.158	3	.719	.096	.962
	Within Groups	209.934	28	7.498		
	Total	212.092	31			
WPI	Between Groups	63.124	3	21.041	2.768	.060
	Within Groups	212.835	28	7.601		
	Total	275.960	31			
Star Rating	Between Groups	.285	3	.095	.045	.987
	Within Groups	59.433	28	2.123		
	Total	59.719	31			

Table 5.20 summarises the results of the ANOVAs conducted focusing upon annual salary. Significant mean differences are found with respect to productivity and expectation on the basis of annual salary.

Table 5. 20 (Case Study #2) ANOVAs by Annual Salary

Variable	Measure	Sum of Square	*df*	Mean Square	*F*	*p*
Satisfaction	Between Groups	2.553	2	1.276	.110	.896
	Within Groups	289.046	25	11.562		
	Total	291.599	27			
Comfort	Between Groups	11.334	2	5.667	.536	.592
	Within Groups	264.395	25	10.576		
	Total	275.729	27			
Productivity	Between Groups	59.770	2	29.885	4.151	.028
	Within Groups	180.000	25	7.200		
	Total	239.770	27			
Happiness	Between Groups	.838	2	.419	.047	.954
	Within Groups	220.811	25	8.832		
	Total	221.649	27			
Efficiency	Between Groups	20.944	2	10.472	1.816	.183
	Within Groups	144.124	25	5.765		
	Total	165.067	27			
Empowerment	Between Groups	15.633	2	7.816	1.003	.381
	Within Groups	194.872	25	7.795		
	Total	210.504	27			
Complexity	Between Groups	14.080	2	7.040	1.182	.323
	Within Groups	148.907	25	5.956		
	Total	162.987	27			
Expectation	Between Groups	32.583	2	16.292	13.680	.000
	Within Groups	29.774	25	1.191		
	Total	62.357	27			
WEI	Between Groups	7.703	2	3.852	.576	.569
	Within Groups	167.184	25	6.687		
	Total	174.887	27			
WPI	Between Groups	3.991	2	1.996	.291	.750
	Within Groups	171.396	25	6.856		
	Total	175.387	27			
Star Rating	Between Groups	1.313	2	.656	.332	.720
	Within Groups	49.366	25	1.975		
	Total	50.679	27			

Independent-samples t-tests are conducted on the basis of respondent gender. In Table 5.21, significant mean differences are indicated in satisfaction, happiness, and complexity on the basis of respondent gender.

Table 5. 21 (Case Study #2) Independent-Samples t-Test by Gender

Variable	*F*	*p*	*t*	*df*	*p*	Mean Diff.
Satisfaction	1.188	.285	-2.653	30	.013	-2.930
Comfort	.253	.619	-1.974	30	.058	-2.212
Productivity	.411	.526	.011	30	.991	0.013
Happiness	.894	.352	-2.838	30	.008	-2.693
Efficiency	.124	.727	-1.224	30	.230	-1.121
Empowerment	.368	.549	-1.319	30	.197	-1.397
Complexity	1.036	.317	-2.605	30	.014	-2.533
Expectation	6.526	.016	-2.125	30	.052	-2.125
WEI	1.018	.321	-1.899	30	.067	-1.742
WPI	6.684	.015	.314	30	.758	0.408
Star Rating	.658	.424	-1.881	30	.070	-0.917

Employment in the organisation is focused upon in Table 5.22. Among these analyses, significant mean differences are indicated in efficiency and expectation on the basis of employment in the organisation.

Table 5. 22 (Case Study #2) ANOVAs by Employed in Organisation

Variable	Measure	Sum of Square	*df*	Mean Square	*F*	*p*
Satisfaction	Between Groups	35.804	2	17.902	1.714	.198
	Within Groups	302.975	29	10.447		
	Total	338.779	31			
Comfort	Between Groups	35.813	2	17.906	1.834	.178
	Within Groups	283.190	29	9.765		
	Total	319.002	31			
Productivity	Between Groups	48.600	2	24.300	2.643	.088
	Within Groups	266.600	29	9.193		
	Total	315.200	31			
Happiness	Between Groups	24.469	2	12.235	1.526	.234
	Within Groups	232.447	29	8.015		
	Total	256.916	31			
Efficiency	Between Groups	43.653	2	21.826	4.097	.027
	Within Groups	154.494	29	5.327		
	Total	198.147	31			
Empowerment	Between Groups	41.497	2	20.748	2.668	.086
	Within Groups	225.529	29	7.777		
	Total	267.026	31			
Complexity	Between Groups	26.487	2	13.243	1.638	.212
	Within Groups	234.493	29	8.086		
	Total	260.980	31			
Expectation	Between Groups	63.690	2	31.845	6.984	.003

	Within Groups	132.240	29	4.560		
	Total	195.930	31			
WEI	Between Groups	35.942	2	17.971	2.959	.068
	Within Groups	176.150	29	6.074		
	Total	212.092	31			
WPI	Between Groups	32.927	2	16.463	1.965	.158
	Within Groups	243.033	29	8.380		
	Total	275.960	31			
Star Rating	Between Groups	7.552	2	3.776	2.099	.141
	Within Groups	52.167	29	1.799		
	Total	59.719	31			

Next, Table 5.23 summarises the results of the independent-samples t-tests conducted with time worked. These analyses find statistical significance only with respect to WPI.

Table 5. 23 (Case Study #2) Independent-Samples t-Test by Time Worked

Variable	*F*	*p*	*t*	*df*	*p*	Mean Diff.
Satisfaction	.515	.478	1.301	30	.203	1.818
Comfort	1.103	.302	.974	30	.338	1.337
Productivity	.752	.393	1.234	30	.227	1.669
Happiness	.099	.756	1.240	30	.225	1.513
Efficiency	.189	.667	1.417	30	.167	1.508
Empowerment	.099	.755	1.363	30	.183	1.688
Complexity	.085	.773	.679	30	.502	0.850
Expectation	.000	.994	-1.772	30	.086	-1.843
WEI	.003	.954	1.414	30	.168	1.557
WPI	1.856	.183	-2.244	30	.032	-2.693
Star Rating	.006	.939	1.192	30	.243	0.703

Table 5.24 presents the results of a series of ANOVAs conducted with main motivation. Here, significant mean differences are found in comfort on the basis of main motivation.

Table 5. 24 (Case Study #2) ANOVAs by Main Motivation

Variable	Measure	Sum of Square	*df*	Mean Square	*F*	*p*
Satisfaction	Between Groups	26.871	3	8.957	.804	.502
	Within Groups	311.907	28	11.140		
	Total	338.779	31			
Comfort	Between Groups	116.372	3	38.791	5.360	.005
	Within Groups	202.631	28	7.237		
	Total	319.002	31			
Productivity	Between Groups	15.038	3	5.013	.468	.707
	Within Groups	300.162	28	10.720		
	Total	315.200	31			
Happiness	Between Groups	58.338	3	19.446	2.742	.062
	Within Groups	198.578	28	7.092		
	Total	256.916	31			
Efficiency	Between Groups	37.235	3	12.412	2.160	.115
	Within Groups	160.912	28	5.747		
	Total	198.147	31			
Empowerment	Between Groups	9.235	3	3.078	.334	.801
	Within Groups	257.791	28	9.207		
	Total	267.026	31			
Complexity	Between Groups	40.152	3	13.384	1.697	.190
	Within Groups	220.828	28	7.887		
	Total	260.980	31			
Expectation	Between Groups	11.138	3	3.713	.563	.644
	Within Groups	184.791	28	6.600		
	Total	195.930	31			
WEI	Between Groups	28.652	3	9.551	1.458	.247
	Within Groups	183.439	28	6.551		
	Total	212.092	31			
WPI	Between Groups	24.671	3	8.224	.916	.446
	Within Groups	251.288	28	8.975		
	Total	275.960	31			
Star Rating	Between Groups	9.798	3	3.266	1.832	.164
	Within Groups	49.921	28	1.783		
	Total	59.719	31			

Finally, Table 5.25 summarises the results of the ANOVAs conducted with work ethic. Here, no statistically significant results are found.

Table 5. 25 (Case Study #2) ANOVAs by Work Ethic

Variable	Measure	Sum of Square	*df*	Mean Square	*F*	*p*
Satisfaction	Between Groups	20.924	2	10.462	.955	.397
	Within Groups	317.854	29	10.960		
	Total	338.779	31			
Comfort	Between Groups	.003	2	.001	.000	1.000
	Within Groups	318.999	29	11.000		
	Total	319.002	31			
Productivity	Between Groups	6.445	2	3.222	.303	.741
	Within Groups	308.755	29	10.647		
	Total	315.200	31			
Happiness	Between Groups	6.359	2	3.179	.368	.695
	Within Groups	250.558	29	8.640		
	Total	256.916	31			
Efficiency	Between Groups	2.291	2	1.146	.170	.845
	Within Groups	195.856	29	6.754		
	Total	198.147	31			
Empowerment	Between Groups	10.309	2	5.154	.582	.565
	Within Groups	256.717	29	8.852		
	Total	267.026	31			
Complexity	Between Groups	15.892	2	7.946	.940	.402
	Within Groups	245.088	29	8.451		
	Total	260.980	31			
Expectation	Between Groups	1.482	2	.741	.111	.896
	Within Groups	194.447	29	6.705		
	Total	195.930	31			
WEI	Between Groups	5.744	2	2.872	.404	.672
	Within Groups	206.347	29	7.115		
	Total	212.092	31			
WPI	Between Groups	9.382	2	4.691	.510	.606
	Within Groups	266.577	29	9.192		
	Total	275.960	31			
Star Rating	Between Groups	1.853	2	.926	.464	.633
	Within Groups	57.866	29	1.995		
	Total	59.719	31			

5.5 Results of Case Study #3

As with the previous sets of data, the initial set of analyses conducted consist of Pearson's correlations between satisfaction, comfort and productivity. First, a positive, borderline strong, statistically significant correlation is found between satisfaction and comfort with respect to these data, $r(27) = .495$, $p < .01$. Next, a positive, moderate, though non-significant correlation is found between satisfaction and productivity, $r(27) = .353$, $p = .06$, while a positive,

moderate, statistically significant correlation is found between comfort and productivity, $r(27) = .401$, $p < .05$.

Partial correlations are then conducted between these three measures, controlling for the effect of complexity. Here, significant correlations are not found in any case, either between satisfaction and comfort, $r(24) = .289$, $p = .135$, satisfaction and productivity, $r(24) = .308$, $p = .111$, or comfort and productivity, $r(24) = .364$, $p = .057$. These results indicate that complexity serves as an important moderator in these data with respect to these relationships.

As shown in Table 5.26, in the initial regression analysis conducted, satisfaction is regressed upon comfort. This effect is found to achieve statistical significance, with a one-unit increase in comfort being associated with a .463 unit increase in satisfaction. The second regression analysis regresses productivity upon satisfaction, with significance not being indicated in this analysis. Following this, productivity is regressed upon comfort, with significance being found. In this analysis, a one unit increase in comfort is found to be associated with a .377 unit increase in productivity. In the fourth linear regression analysis, satisfaction is regressed upon comfort, complexity, and the interaction between comfort and complexity. This analysis did not find statistical significance in any case. Next, the fifth regression model regresses productivity upon the main effects of satisfaction and complexity, along with the interaction between these two measures. Significant results are also not found in any case in this analysis. Finally, the sixth regression model regresses productivity upon comfort, complexity, as well as the interaction between these two measures, with no significant findings indicated here either. Only the first, third and fourth regression models are found to achieve statistical significance.

Table 5. 26 (Case Study #3) Regression Analyses

Measure	*B*	*SE*	Beta	*t*	*p*	Tol.	VIF
Satisfaction							
(Constant)	1.688	.479		3.522	.002		
Comfort	.463	.157	.495	2.958	.006	1.000	1.000
Productivity							
(Constant)	3.031	.618		4.900	.000		
Satisfaction	.354	.181	.353	1.960	.060	1.000	1.000
Productivity							
(Constant)	3.519	.508		6.934	.000		
Comfort	.377	.166	.401	2.272	.031	1.000	1.000
Satisfaction							
(Constant)	.967	.532		1.816	.081		
Comfort	.259	.166	.277	1.563	.131	.727	1.376
Complexity	.163	.245	.154	.664	.513	.423	2.362
Comfort*Complexity	.124	.074	.360	1.679	.106	.498	2.009
Productivity							
(Constant)	2.990	.672		4.453	.000		
Satisfaction	.397	.226	.395	1.753	.092	.672	1.489
Complexity	.097	.277	.091	.350	.729	.502	1.992
Satis.*Complexity	-.054	.068	-.197	-.802	.430	.564	1.774
Productivity							
(Constant)	3.582	.647		5.533	.000		
Comfort	.394	.202	.419	1.953	.062	.727	1.376
Complexity	-.088	.298	-.083	-.295	.770	.423	2.362
Comfort*Complexity	.023	.090	.066	.253	.802	.498	2.009

Note. [a]$F(1, 27) = 8.747$, $p < .01$; $R^2 = .245$; [b]$F(1, 27) = 3.840$, $p = .060$; $R^2 = .125$; [c]$F(1, 27) = 5.164$, $p < .05$; $R^2 = .161$; [d]$F(3, 25) = 6.260$, $p < .01$; $R^2 = .429$; [e]$F(3, 25) = 1.433$, $p = .257$; $R^2 = .147$; [f]$F(3, 25) = 1.631$, $p = .207$; $R^2 = .164$.

Next, a series of difference in mean tests are conducted with the demographic and related measures included within this study. Table 5.27 summarises the results of the ANOVAs conducted on the basis of respondent age. Among these analyses, significant mean differences are only found with respect to expectation on the basis of respondent age.

Table 5. 27 (Case Study #3) ANOVAs by Age

Variable	Measure	Sum of Square	*df*	Mean Square	*F*	*p*
Satisfaction	Between Groups	32.568	3	10.856	1.366	.276
	Within Groups	198.750	25	7.950		
	Total	231.318	28			
Comfort	Between Groups	23.979	3	7.993	.833	.488
	Within Groups	239.783	25	9.591		
	Total	263.761	28			
Productivity	Between Groups	16.191	3	5.397	.621	.608
	Within Groups	217.183	25	8.687		
	Total	233.374	28			
Happiness	Between Groups	14.928	3	4.976	.694	.564
	Within Groups	179.246	25	7.170		
	Total	194.174	28			
Efficiency	Between Groups	15.519	3	5.173	.769	.522
	Within Groups	168.187	25	6.727		
	Total	183.706	28			
Empowerment	Between Groups	24.348	3	8.116	1.427	.258
	Within Groups	142.180	25	5.687		
	Total	166.528	28			
Complexity	Between Groups	27.832	3	9.277	1.294	.298
	Within Groups	179.287	25	7.171		
	Total	207.119	28			
Expectation	Between Groups	43.064	3	14.355	3.629	.027
	Within Groups	98.902	25	3.956		
	Total	141.966	28			
WEI	Between Groups	15.851	3	5.284	.930	.441
	Within Groups	142.081	25	5.683		
	Total	157.932	28			
WPI	Between Groups	17.589	3	5.863	1.573	.221
	Within Groups	93.182	25	3.727		
	Total	110.770	28			
Star Rating	Between Groups	3.060	3	1.020	.912	.449
	Within Groups	27.974	25	1.119		
	Total	31.034	28			

Table 5.28 summarises the results of the ANOVAs conducted with the respondent's current role. Here, significant mean differences are found in complexity and expectation.

Table 5. 28 (Case Study #3) ANOVAs by Current Role

Variable	Measure	Sum of Square	*df*	Mean Square	*F*	*p*
Satisfaction	Between Groups	25.306	2	12.653	1.597	.222
	Within Groups	206.012	26	7.924		
	Total	231.318	28			
Comfort	Between Groups	13.601	2	6.801	.707	.502
	Within Groups	250.160	26	9.622		
	Total	263.761	28			
Productivity	Between Groups	6.470	2	3.235	.371	.694
	Within Groups	226.904	26	8.727		
	Total	233.374	28			
Happiness	Between Groups	19.053	2	9.526	1.414	.261
	Within Groups	175.122	26	6.735		
	Total	194.174	28			
Efficiency	Between Groups	4.995	2	2.497	.363	.699
	Within Groups	178.711	26	6.874		
	Total	183.706	28			
Empowerment	Between Groups	5.110	2	2.555	.412	.667
	Within Groups	161.418	26	6.208		
	Total	166.528	28			
Complexity	Between Groups	96.155	2	48.078	11.265	.000
	Within Groups	110.964	26	4.268		
	Total	207.119	28			
Expectation	Between Groups	98.978	2	49.489	29.932	.000
	Within Groups	42.988	26	1.653		
	Total	141.966	28			
WEI	Between Groups	7.712	2	3.856	.667	.522
	Within Groups	150.220	26	5.778		
	Total	157.932	28			
WPI	Between Groups	1.384	2	.692	.165	.849
	Within Groups	109.386	26	4.207		
	Total	110.770	28			
Star Rating	Between Groups	.834	2	.417	.359	.702
	Within Groups	30.200	26	1.162		
	Total	31.034	28			

The next series of ANOVAs focus upon primary workspace type. In Table 5.29, significant mean differences in complexity and expectation are found on the basis of primary workspace type.

Table 5. 29 (Case Study #3) ANOVAs by Primary Workspace Type

Variable	Measure	Sum of Square	*df*	Mean Square	*F*	*p*
Satisfaction	Between Groups	27.367	2	13.683	1.744	.195
	Within Groups	203.951	26	7.844		
	Total	231.318	28			
Comfort	Between Groups	5.321	2	2.661	.268	.767
	Within Groups	258.440	26	9.940		
	Total	263.761	28			
Productivity	Between Groups	13.193	2	6.596	.779	.469
	Within Groups	220.182	26	8.469		
	Total	233.374	28			
Happiness	Between Groups	14.029	2	7.014	1.012	.377
	Within Groups	180.145	26	6.929		
	Total	194.174	28			
Efficiency	Between Groups	6.452	2	3.226	.473	.628
	Within Groups	177.253	26	6.817		
	Total	183.706	28			
Empowerment	Between Groups	10.419	2	5.209	.868	.432
	Within Groups	156.109	26	6.004		
	Total	166.528	28			
Complexity	Between Groups	101.484	2	50.742	12.489	.000
	Within Groups	105.635	26	4.063		
	Total	207.119	28			
Expectation	Between Groups	79.432	2	39.716	16.513	.000
	Within Groups	62.533	26	2.405		
	Total	141.966	28			
WEI	Between Groups	8.662	2	4.331	.754	.480
	Within Groups	149.270	26	5.741		
	Total	157.932	28			
WPI	Between Groups	4.349	2	2.175	.531	.594
	Within Groups	106.421	26	4.093		
	Total	110.770	28			
Star Rating	Between Groups	.901	2	.451	.389	.682
	Within Groups	30.133	26	1.159		
	Total	31.034	28			

The respondent's level of formal education is then focused upon. Among these analyses, significant mean differences in expectation and WPI are found in Table 5.30 on the basis of the level of formal education.

Table 5. 30 (Case Study #3) ANOVAs by Formal Education

Variable	Measure	Sum of Square	*df*	Mean Square	*F*	*p*
Satisfaction	Between Groups	11.113	3	3.704	.421	.740
	Within Groups	220.205	25	8.808		
	Total	231.318	28			
Comfort	Between Groups	2.905	3	.968	.093	.963
	Within Groups	260.856	25	10.434		
	Total	263.761	28			
Productivity	Between Groups	13.018	3	4.339	.492	.691
	Within Groups	220.357	25	8.814		
	Total	233.374	28			
Happiness	Between Groups	2.554	3	.851	.111	.953
	Within Groups	191.620	25	7.665		
	Total	194.174	28			
Efficiency	Between Groups	6.365	3	2.122	.299	.826
	Within Groups	177.341	25	7.094		
	Total	183.706	28			
Empowerment	Between Groups	.969	3	.323	.049	.985
	Within Groups	165.559	25	6.622		
	Total	166.528	28			
Complexity	Between Groups	48.455	3	16.152	2.545	.079
	Within Groups	158.664	25	6.347		
	Total	207.119	28			
Expectation	Between Groups	50.133	3	16.711	4.549	.011
	Within Groups	91.833	25	3.673		
	Total	141.966	28			
WEI	Between Groups	1.038	3	.346	.055	.983
	Within Groups	156.894	25	6.276		
	Total	157.932	28			
WPI	Between Groups	33.394	3	11.131	3.597	.027
	Within Groups	77.376	25	3.095		
	Total	110.770	28			
Star Rating	Between Groups	.759	3	.253	.209	.889
	Within Groups	30.275	25	1.211		
	Total	31.034	28			

Next, Table 5.31 summarises the ANOVAs conducted with annual salary. Among these analyses, statistical significance is indicated with respect to mean empowerment and expectation on the basis of annual salary.

Table 5. 31 (Case Study #3) ANOVAs by Annual Salary

Variable	Measure	Sum of Square	*df*	Mean Square	*F*	*p*
Satisfaction	Between Groups	23.856	2	11.928	1.630	.217
	Within Groups	175.611	24	7.317		
	Total	199.467	26			
Comfort	Between Groups	31.370	2	15.685	1.731	.199
	Within Groups	217.486	24	9.062		
	Total	248.856	26			
Productivity	Between Groups	39.357	2	19.679	3.194	.059
	Within Groups	147.863	24	6.161		
	Total	187.220	26			
Happiness	Between Groups	16.467	2	8.234	1.290	.294
	Within Groups	153.211	24	6.384		
	Total	169.678	26			
Efficiency	Between Groups	34.404	2	17.202	3.127	.062
	Within Groups	132.012	24	5.501		
	Total	166.416	26			
Empowerment	Between Groups	35.249	2	17.624	3.735	.039
	Within Groups	113.256	24	4.719		
	Total	148.505	26			
Complexity	Between Groups	20.507	2	10.254	3.033	.067
	Within Groups	81.125	24	3.380		
	Total	101.632	26			
Expectation	Between Groups	42.527	2	21.264	22.690	.000
	Within Groups	22.491	24	.937		
	Total	65.019	26			
WEI	Between Groups	27.981	2	13.991	2.940	.072
	Within Groups	114.208	24	4.759		
	Total	142.189	26			
WPI	Between Groups	15.535	2	7.767	2.022	.154
	Within Groups	92.186	24	3.841		
	Total	107.721	26			
Star Rating	Between Groups	5.728	2	2.864	2.997	.069
	Within Groups	22.939	24	.956		
	Total	28.667	26			

Following this, a series of independent-samples t-tests are conducted on the basis of respondent gender. As shown in Table 5.32, no significant mean differences are found in these items on the basis of respondent gender.

Table 5. 32 (Case Study #3) Independent-Samples t-Test by Gender

Variable	*F*	*p*	*t*	*df*	*p*	Mean Diff.
Satisfaction	.042	.840	-.447	27	.658	-0.566
Comfort	.025	.876	-.247	27	.807	-0.335
Productivity	.451	.508	-.430	27	.671	-0.547
Happiness	.062	.805	-.410	27	.685	-0.476
Efficiency	.001	.976	-.416	27	.681	-0.470
Empowerment	.004	.949	-.480	27	.635	-0.515
Complexity	.025	.874	-1.198	27	.241	-1.403
Expectation	2.245	.146	-1.976	27	.058	-1.838
WEI	.188	.668	-.466	27	.645	-0.487
WPI	2.485	.127	-.497	27	.623	-0.435
Star Rating	.154	.698	-.364	27	.719	-0.169

The following series of analyses consist of a set of ANOVAs focusing upon employment in the organisation. Among these analyses, significant mean differences are found with respect to satisfaction, happiness, efficiency, empowerment, WEI, WPI, and star rating on the basis of employment in the organisation, as depicted in Table 5.33.

Table 5. 33 (Case Study #3) ANOVAs by Employed in Organisation

Variable	Measure	Sum of Square	*df*	Mean Square	*F*	*p*
Satisfaction	Between Groups	73.205	3	24.402	3.858	.021
	Within Groups	158.113	25	6.325		
	Total	231.318	28			
Comfort	Between Groups	49.637	3	16.546	1.932	.150
	Within Groups	214.124	25	8.565		
	Total	263.761	28			
Productivity	Between Groups	57.661	3	19.220	2.735	.065
	Within Groups	175.714	25	7.029		
	Total	233.374	28			
Happiness	Between Groups	57.069	3	19.023	3.469	.031
	Within Groups	137.105	25	5.484		
	Total	194.174	28			
Efficiency	Between Groups	52.779	3	17.593	3.359	.035
	Within Groups	130.927	25	5.237		
	Total	183.706	28			

Empowerment	Between Groups	48.984	3	16.328	3.473	.031
	Within Groups	117.544	25	4.702		
	Total	166.528	28			
Complexity	Between Groups	12.823	3	4.274	.550	.653
	Within Groups	194.295	25	7.772		
	Total	207.119	28			
Expectation	Between Groups	12.009	3	4.003	.770	.522
	Within Groups	129.957	25	5.198		
	Total	141.966	28			
WEI	Between Groups	50.070	3	16.690	3.868	.021
	Within Groups	107.862	25	4.314		
	Total	157.932	28			
WPI	Between Groups	34.279	3	11.426	3.735	.024
	Within Groups	76.491	25	3.060		
	Total	110.770	28			
Star Rating	Between Groups	8.716	3	2.905	3.254	.038
	Within Groups	22.319	25	.893		
	Total	31.034	28			

Table 5.34 summarises the independent-samples t-tests conducted with time worked. Here, significant mean differences are found with respect to happiness, WEI and WPI on the basis of time worked.

Table 5. 34 (Case Study #3) Independent-Samples t-Test by Time Worked

Variable	*F*	*p*	*t*	*df*	*p*	Mean Diff.
Satisfaction	.534	.471	1.895	27	.069	2.261
Comfort	.036	.852	2.006	27	.055	2.538
Productivity	.045	.834	1.008	27	.322	1.262
Happiness	1.395	.248	2.294	27	.030	2.442
Efficiency	.223	.640	1.803	27	.083	1.928
Empowerment	1.065	.311	1.642	27	.112	1.688
Complexity	.800	.379	.369	27	.715	0.442
Expectation	1.964	.172	-1.316	27	.199	-1.269
WEI	.977	.332	2.068	27	.048	2.017
WPI	.538	.469	-2.101	27	.045	-1.712
Star Rating	1.205	.282	1.655	27	.109	0.734

Following this, a series of ANOVAs are conducted with main motivation. As presented in Table 5.35, no significant results are indicated in this set of analyses.

Table 5. 35 (Case Study #3) ANOVAs by Main Motivation

Variable	Measure	Sum of Square	*df*	Mean Square	*F*	*p*
Satisfaction	Between Groups	23.622	3	7.874	.948	.433
	Within Groups	207.696	25	8.308		
	Total	231.318	28			
Comfort	Between Groups	9.833	3	3.278	.323	.809
	Within Groups	253.928	25	10.157		
	Total	263.761	28			
Productivity	Between Groups	4.828	3	1.609	.176	.912
	Within Groups	228.546	25	9.142		
	Total	233.374	28			
Happiness	Between Groups	14.548	3	4.849	.675	.576
	Within Groups	179.627	25	7.185		
	Total	194.174	28			
Efficiency	Between Groups	2.731	3	.910	.126	.944
	Within Groups	180.975	25	7.239		
	Total	183.706	28			
Empowerment	Between Groups	2.258	3	.753	.115	.951
	Within Groups	164.270	25	6.571		
	Total	166.528	28			
Complexity	Between Groups	31.781	3	10.594	1.510	.236
	Within Groups	175.338	25	7.014		
	Total	207.119	28			
Expectation	Between Groups	13.059	3	4.353	.844	.483
	Within Groups	128.906	25	5.156		
	Total	141.966	28			
WEI	Between Groups	3.901	3	1.300	.211	.888
	Within Groups	154.031	25	6.161		
	Total	157.932	28			
WPI	Between Groups	16.027	3	5.342	1.410	.263
	Within Groups	94.744	25	3.790		
	Total	110.770	28			
Star Rating	Between Groups	.409	3	.136	.111	.953
	Within Groups	30.625	25	1.225		
	Total	31.034	28			

Finally, Table 5.36 summarises the results of the ANOVAs conducted with work ethic. Here, no significant results are found at all.

Table 5. 36 (Case Study #3) ANOVAs by Work Ethic

Variable	Measure	Sum of Square	*df*	Mean Square	*F*	*p*
Satisfaction	Between Groups	22.119	3	7.373	.881	.464
	Within Groups	209.199	25	8.368		
	Total	231.318	28			
Comfort	Between Groups	10.738	3	3.579	.354	.787
	Within Groups	253.023	25	10.121		
	Total	263.761	28			
Productivity	Between Groups	8.175	3	2.725	.303	.823
	Within Groups	225.199	25	9.008		
	Total	233.374	28			
Happiness	Between Groups	10.749	3	3.583	.488	.693
	Within Groups	183.425	25	7.337		
	Total	194.174	28			
Efficiency	Between Groups	2.225	3	.742	.102	.958
	Within Groups	181.481	25	7.259		
	Total	183.706	28			
Empowerment	Between Groups	7.591	3	2.530	.398	.756
	Within Groups	158.937	25	6.357		
	Total	166.528	28			
Complexity	Between Groups	6.857	3	2.286	.285	.836
	Within Groups	200.262	25	8.010		
	Total	207.119	28			
Expectation	Between Groups	7.361	3	2.454	.456	.716
	Within Groups	134.604	25	5.384		
	Total	141.966	28			
WEI	Between Groups	4.366	3	1.455	.237	.870
	Within Groups	153.566	25	6.143		
	Total	157.932	28			
WPI	Between Groups	2.238	3	.746	.172	.914
	Within Groups	108.533	25	4.341		
	Total	110.770	28			
Star Rating	Between Groups	.451	3	.150	.123	.946
	Within Groups	30.583	25	1.223		
	Total	31.034	28			

5.6 Results of Case Study #4

Again, a series of Pearson's correlations are conducted between the measures of satisfaction, comfort, and productivity. The correlation between satisfaction and comfort is found to be positive, moderate, and statistically significant, $r(176) = .450$, $p < .001$. The correlation between satisfaction and productivity is found to be positive and weak, though statistically significant, $r(176) = .210$, $p < .01$. A positive, moderate, statistically significant correlation is indicated between comfort and productivity, $r(176) = .427$, $p < .001$.

These same three correlations are conducted a second time as partial correlations, with the effect of complexity being controlled. First, with regard to the correlation between satisfaction and comfort, this is found to be positive, moderate in strength, and statistically significant, $r(173) = .415$, $p < .001$. Next, the correlation between satisfaction and productivity is found to be positive, weak and significant in these analyses, $r(173) = .170$, $p < .05$, while the correlation between comfort and productivity is found to be positive, moderate in strength, and statistically significant, $r(173) = .409$, $p < .001$. These results indicate that complexity does serve as a moderator with respect to these three associations, though this effect is not very large.

Table 5.37 summarises the results of the analyses conducted focusing upon these hypotheses. In the initial regression analysis conducted, satisfaction is regressed upon comfort. Here, statistical significance is indicated, with a one-unit increase in comfort being associated with a .423 unit increase in satisfaction. The second regression analysis regresses productivity upon satisfaction. Statistical significance is also indicated here, with a one unit increase in satisfaction being associated with a .189 unit increase in productivity. Following this, productivity is regressed upon comfort, with significance also being found. In this analysis, a one unit increase in comfort is found to be associated with a .361 unit increase in productivity. In the fourth linear regression analysis, satisfaction is regressed upon comfort, complexity, and the interaction between comfort and complexity. This analysis indicates statistical significance with regard to the main effects of comfort and complexity, though not with regard to the interaction between these two items. It is found that a one unit increase in comfort was associated with a .378 unit increase in satisfaction, while a one unit increase in complexity is associated with a .382 unit increase in satisfaction. The fifth regression model regresses productivity upon the main effects of satisfaction and complexity, along with the interaction between these two measures. The results of this analysis indicate significance with respect to the main effect of satisfaction as well as the interaction between satisfaction and complexity. Here, a one unit increase in satisfaction is found to be associated with a .196 unit increase in productivity, while the positive coefficient associated with the significant interaction effect indicates that the effect of satisfaction on productivity is stronger and more positive with higher levels of complexity. Finally, the sixth

regression model regresses productivity upon comfort, complexity, as well as the interaction between these two measures. In this model, statistical significance is only indicated with respect to the main effect of comfort. Specifically, a one unit increase in comfort is found to be associated with a .355 unit increase in productivity. All of these regression models with the exception of the fifth model are found to achieve statistical significance.

Table 5. 37 (Case Study #4) Regression Analyses

Measure	*B*	*SE*	Beta	*t*	*p*	Tol.	VIF
Satisfaction							
(Constant)	.426	.207		2.061	.041		
Comfort	.423	.063	.450	6.681	.000	1.000	1.000
Productivity							
(Constant)	3.523	.206		17.141	.000		
Satisfaction	.189	.066	.210	2.854	.005	1.000	1.000
Productivity							
(Constant)	3.592	.188		19.084	.000		
Comfort	.361	.058	.427	6.261	.000	1.000	1.000
Satisfaction							
(Constant)	-.092	.239		-.386	.700		
Comfort	.378	.062	.401	6.043	.000	.948	1.055
Complexity	.382	.104	.256	3.669	.000	.856	1.168
Comfort*Complexity	.011	.023	.033	.481	.631	.888	1.127
Productivity							
(Constant)	3.261	.245		13.319	.000		
Satisfaction	.196	.071	.218	2.744	.007	.839	1.192
Complexity	.087	.105	.065	.823	.411	.860	1.162
Satis.*Complexity	.061	.027	.170	2.275	.024	.947	1.056
Productivity							
(Constant)	3.483	.227		15.375	.000		
Comfort	.355	.059	.420	6.002	.000	.948	1.055
Complexity	.068	.099	.050	.685	.495	.856	1.168
Comfort*Complexity	.020	.022	.066	.919	.359	.888	1.127

Note. [a]$F(1, 176) = 44.636$, $p < .001$; $R^2 = .202$; [b]$F(1, 176) = 8.146$, $p < .01$; $R^2 = .044$; [c]$F(1, 176) = 39.194$, $p < .001$; $R^2 = .182$; [d]$F(3, 174) = 21.688$, $p < .001$; $R^2 = .272$; [e]$F(3, 174) = 4.977$, $p < .01$; $R^2 = .079$; [f]$F(3, 174) = 13.709$, $p < .001$; $R^2 = .191$.

Following this, further analyses are again conducted focusing upon respondent demographics. First, Table 5.38 summarises the results of a series of one-way ANOVAs conducted with respondent age. Among these analyses, significant differences in expectation and WPI are found on the basis of respondent age.

Table 5. 38 (Case Study #4) ANOVAs by Age

Variable	Measure	Sum of Square	*df*	Mean Square	*F*	*p*
Satisfaction	Between Groups	30.011	3	10.004	1.054	.370
	Within Groups	1650.989	174	9.488		
	Total	1681.000	177			
Comfort	Between Groups	52.606	3	17.535	1.651	.179
	Within Groups	1847.652	174	10.619		
	Total	1900.258	177			
Productivity	Between Groups	14.498	3	4.833	.627	.599
	Within Groups	1341.843	174	7.712		
	Total	1356.341	177			
Happiness	Between Groups	38.493	3	12.831	1.700	.169
	Within Groups	1312.996	174	7.546		
	Total	1351.488	177			
Efficiency	Between Groups	24.825	3	8.275	1.226	.302
	Within Groups	1174.514	174	6.750		
	Total	1199.339	177			
Empowerment	Between Groups	19.758	3	6.586	1.200	.312
	Within Groups	955.298	174	5.490		
	Total	975.056	177			
Complexity	Between Groups	7.855	3	2.618	.609	.610
	Within Groups	747.872	174	4.298		
	Total	755.727	177			
Expectation	Between Groups	111.377	3	37.126	17.468	.000
	Within Groups	369.810	174	2.125		
	Total	481.187	177			
WEI	Between Groups	25.794	3	8.598	1.528	.209
	Within Groups	979.074	174	5.627		
	Total	1004.868	177			
WPI	Between Groups	88.749	3	29.583	7.288	.000
	Within Groups	706.247	174	4.059		
	Total	794.996	177			
Star Rating	Between Groups	4.897	3	1.632	1.450	.230
	Within Groups	195.806	174	1.125		
	Total	200.702	177			

Table 5.39 summarises the results of the ANOVAs conducted with current role. These analyses indicate significant mean differences in complexity as well as expectation on the basis of the respondent's current role.

Table 5. 39 (Case Study #4) ANOVAs by Current Role

Variable	Measure	Sum of Square	*df*	Mean Square	*F*	*p*
Satisfaction	Between Groups	66.890	3	22.297	2.404	.069
	Within Groups	1614.110	174	9.276		
	Total	1681.000	177			
Comfort	Between Groups	68.518	3	22.839	2.170	.093
	Within Groups	1831.740	174	10.527		
	Total	1900.258	177			
Productivity	Between Groups	.644	3	.215	.028	.994
	Within Groups	1355.697	174	7.791		
	Total	1356.341	177			
Happiness	Between Groups	58.813	3	19.604	2.639	.051
	Within Groups	1292.675	174	7.429		
	Total	1351.488	177			
Efficiency	Between Groups	17.345	3	5.782	.851	.468
	Within Groups	1181.994	174	6.793		
	Total	1199.339	177			
Empowerment	Between Groups	17.425	3	5.808	1.055	.370
	Within Groups	957.631	174	5.504		
	Total	975.056	177			
Complexity	Between Groups	146.674	3	48.891	13.968	.000
	Within Groups	609.053	174	3.500		
	Total	755.727	177			
Expectation	Between Groups	237.938	3	79.313	56.734	.000
	Within Groups	243.248	174	1.398		
	Total	481.187	177			
WEI	Between Groups	25.936	3	8.645	1.537	.207
	Within Groups	978.932	174	5.626		
	Total	1004.868	177			
WPI	Between Groups	24.739	3	8.246	1.863	.138
	Within Groups	770.258	174	4.427		
	Total	794.996	177			
Star Rating	Between Groups	5.897	3	1.966	1.756	.157
	Within Groups	194.805	174	1.120		
	Total	200.702	177			

A series of ANOVAs are conducted focusing upon the mean differences in these measures on the basis of primary workspace type. As indicated in Table 5.40, significant differences in comfort, complexity, expectation and WPI are found on the basis of the primary workspace type.

Table 5. 40 (Case Study #4) ANOVAs by Primary Workspace Type

Variable	Measure	Sum of Square	*df*	Mean Square	*F*	*p*
Satisfaction	Between Groups	24.889	3	8.296	.872	.457
	Within Groups	1656.112	174	9.518		
	Total	1681.000	177			
Comfort	Between Groups	88.677	3	29.559	2.839	.039
	Within Groups	1811.581	174	10.411		
	Total	1900.258	177			
Productivity	Between Groups	19.009	3	6.336	.824	.482
	Within Groups	1337.332	174	7.686		
	Total	1356.341	177			
Happiness	Between Groups	35.836	3	11.945	1.580	.196
	Within Groups	1315.652	174	7.561		
	Total	1351.488	177			
Efficiency	Between Groups	48.316	3	16.105	2.435	.067
	Within Groups	1151.023	174	6.615		
	Total	1199.339	177			
Empowerment	Between Groups	8.235	3	2.745	.494	.687
	Within Groups	966.821	174	5.556		
	Total	975.056	177			
Complexity	Between Groups	51.657	3	17.219	4.255	.006
	Within Groups	704.070	174	4.046		
	Total	755.727	177			
Expectation	Between Groups	63.057	3	21.019	8.747	.000
	Within Groups	418.129	174	2.403		
	Total	481.187	177			
WEI	Between Groups	26.422	3	8.807	1.566	.199
	Within Groups	978.445	174	5.623		
	Total	1004.868	177			
WPI	Between Groups	36.625	3	12.208	2.801	.041
	Within Groups	758.372	174	4.358		
	Total	794.996	177			
Star Rating	Between Groups	8.226	3	2.742	2.479	.063
	Within Groups	192.476	174	1.106		
	Total	200.702	177			

The following series of ANOVAs focus upon formal education (see Table 5.41). Among these analyses, significant differences in the mean level of complexity, expectation and WPI are found on the basis of formal education.

Table 5. 41 (Case Study #4) ANOVAs by Formal Education

Variable	Measure	Sum of Square	*df*	Mean Square	*F*	*p*
Satisfaction	Between Groups	16.483	3	5.494	.574	.633
	Within Groups	1664.518	174	9.566		
	Total	1681.000	177			
Comfort	Between Groups	25.671	3	8.557	.794	.499
	Within Groups	1874.587	174	10.773		
	Total	1900.258	177			
Productivity	Between Groups	5.141	3	1.714	.221	.882
	Within Groups	1351.200	174	7.766		
	Total	1356.341	177			
Happiness	Between Groups	15.378	3	5.126	.668	.573
	Within Groups	1336.110	174	7.679		
	Total	1351.488	177			
Efficiency	Between Groups	11.352	3	3.784	.554	.646
	Within Groups	1187.987	174	6.828		
	Total	1199.339	177			
Empowerment	Between Groups	4.690	3	1.563	.280	.840
	Within Groups	970.366	174	5.577		
	Total	975.056	177			
Complexity	Between Groups	38.216	3	12.739	3.089	.029
	Within Groups	717.511	174	4.124		
	Total	755.727	177			
Expectation	Between Groups	121.190	3	40.397	19.525	.000
	Within Groups	359.997	174	2.069		
	Total	481.187	177			
WEI	Between Groups	8.698	3	2.899	.506	.678
	Within Groups	996.170	174	5.725		
	Total	1004.868	177			
WPI	Between Groups	68.576	3	22.859	5.475	.001
	Within Groups	726.420	174	4.175		
	Total	794.996	177			
Star Rating	Between Groups	2.195	3	.732	.641	.589
	Within Groups	198.508	174	1.141		
	Total	200.702	177			

The next set of ANOVAs focus upon annual salary. In Table 5.42, significant mean differences are found in all variables (except complexity) on the basis of annual salary.

Table 5. 42 (Case Study #4) ANOVAs by Annual Salary

Variable	Measure	Sum of Square	*df*	Mean Square	*F*	*p*
Satisfaction	Between Groups	67.176	2	33.588	3.676	.027
	Within Groups	1489.186	163	9.136		
	Total	1556.362	165			
Comfort	Between Groups	69.635	2	34.817	3.348	.038
	Within Groups	1694.882	163	10.398		
	Total	1764.516	165			
Productivity	Between Groups	46.712	2	23.356	3.158	.045
	Within Groups	1205.359	163	7.395		
	Total	1252.071	165			
Happiness	Between Groups	69.125	2	34.563	4.727	.010
	Within Groups	1191.747	163	7.311		
	Total	1260.873	165			
Efficiency	Between Groups	55.155	2	27.577	4.256	.016
	Within Groups	1056.223	163	6.480		
	Total	1111.378	165			
Empowerment	Between Groups	61.300	2	30.650	5.979	.003
	Within Groups	835.607	163	5.126		
	Total	896.906	165			
Complexity	Between Groups	8.895	2	4.448	1.231	.295
	Within Groups	588.753	163	3.612		
	Total	597.649	165			
Expectation	Between Groups	114.405	2	57.202	48.843	.000
	Within Groups	190.898	163	1.171		
	Total	305.303	165			
WEI	Between Groups	62.239	2	31.119	5.830	.004
	Within Groups	870.028	163	5.338		
	Total	932.267	165			
WPI	Between Groups	61.953	2	30.976	7.988	.000
	Within Groups	632.064	163	3.878		
	Total	694.017	165			
Star Rating	Between Groups	15.554	2	7.777	7.647	.001
	Within Groups	165.777	163	1.017		
	Total	181.331	165			

The next set of analyses conducted consist of a series of independent-samples t-tests which are run on the basis of respondent gender. Among these analyses, significant mean differences in comfort, happiness, expectation, and WEI are found on the basis of respondent gender. Results are provided in Table 5.43.

Table 5. 43 (Case Study #4) Independent-Samples t-Test by Gender

Variable	*F*	*p*	*t*	*df*	*p*	Mean Diff.
Satisfaction	2.723	.101	-1.586	176	.114	-0.772
Comfort	2.660	.105	-2.084	176	.039	-1.073
Productivity	.521	.472	-.289	176	.773	-0.127
Happiness	4.634	.033	-2.525	176	.013	-0.972
Efficiency	1.244	.266	-1.369	176	.173	-0.564
Empowerment	3.110	.080	-1.264	176	.208	-0.470
Complexity	.403	.526	-1.461	176	.146	-0.477
Expectation	.167	.683	-2.048	176	.042	-0.531
WEI	4.008	.047	-2.007	176	.046	-0.668
WPI	.509	.477	-.159	176	.874	-0.054
Star Rating	1.763	.186	-1.308	176	.193	-0.220

Next, a series of ANOVAs are conducted focusing upon employment in the organisation. Among these analyses, statistical significance is only indicated with respect to the measure of expectation. See Table 5.44.

Table 5. 44 (Case Study #4) ANOVAs by Employed in Organisation

Variable	Measure	Sum of Square	*df*	Mean Square	*F*	*p*
Satisfaction	Between Groups	68.802	3	22.934	2.475	.063
	Within Groups	1612.199	174	9.266		
	Total	1681.000	177			
Comfort	Between Groups	35.632	3	11.877	1.108	.347
	Within Groups	1864.626	174	10.716		
	Total	1900.258	177			
Productivity	Between Groups	10.031	3	3.344	.432	.730
	Within Groups	1346.310	174	7.737		
	Total	1356.341	177			
Happiness	Between Groups	53.575	3	17.858	2.394	.070
	Within Groups	1297.913	174	7.459		
	Total	1351.488	177			
Efficiency	Between Groups	16.073	3	5.358	.788	.502
	Within Groups	1183.266	174	6.800		
	Total	1199.339	177			

Empowerment	Between Groups	26.991	3	8.997	1.651	.179
	Within Groups	948.065	174	5.449		
	Total	975.056	177			
Complexity	Between Groups	7.104	3	2.368	.550	.649
	Within Groups	748.623	174	4.302		
	Total	755.727	177			
Expectation	Between Groups	23.577	3	7.859	2.988	.033
	Within Groups	457.610	174	2.630		
	Total	481.187	177			
WEI	Between Groups	30.212	3	10.071	1.798	.149
	Within Groups	974.656	174	5.601		
	Total	1004.868	177			
WPI	Between Groups	7.538	3	2.513	.555	.645
	Within Groups	787.459	174	4.526		
	Total	794.996	177			
Star Rating	Between Groups	6.337	3	2.112	1.891	.133
	Within Groups	194.365	174	1.117		
	Total	200.702	177			

Table 5.45 summarises the results of the independent-samples t-tests conducted focusing upon time worked. Among these analyses, significant mean differences are indicated with respect to satisfaction, comfort, happiness, efficiency, empowerment, WEI and star rating on the basis of time worked.

Table 5. 45 (Case Study #4) Independent-Samples t-Test by Time Worked

Variable	*F*	*p*	*t*	*df*	*p*	Mean Diff.
Satisfaction	.001	.977	3.410	176	.001	1.925
Comfort	2.131	.146	2.968	176	.003	1.795
Productivity	1.173	.280	1.080	176	.282	0.563
Happiness	1.405	.237	3.746	176	.000	1.884
Efficiency	3.992	.047	2.727	176	.008	1.162
Empowerment	.627	.430	2.869	176	.005	1.245
Complexity	.285	.594	1.341	176	.182	0.521
Expectation	2.810	.095	-.731	176	.466	-0.227
WEI	2.171	.142	3.265	176	.001	1.429
WPI	.022	.883	-1.887	176	.061	-0.749
Star Rating	4.266	.040	3.608	176	.001	0.626

The following set of ANOVAs focus upon the respondent's main motivation. Among these analyses, significant mean differences are only found with respect to expectation. See Table 5.46.

Table 5. 46 (Case Study #4) ANOVAs by Main Motivation

Variable	Measure	Sum of Square	*df*	Mean Square	*F*	*p*
Satisfaction	Between Groups	11.375	3	3.792	.395	.757
	Within Groups	1669.625	174	9.596		
	Total	1681.000	177			
Comfort	Between Groups	49.531	3	16.510	1.552	.203
	Within Groups	1850.727	174	10.636		
	Total	1900.258	177			
Productivity	Between Groups	17.561	3	5.854	.761	.518
	Within Groups	1338.779	174	7.694		
	Total	1356.341	177			
Happiness	Between Groups	11.058	3	3.686	.478	.698
	Within Groups	1340.430	174	7.704		
	Total	1351.488	177			
Efficiency	Between Groups	26.349	3	8.783	1.303	.275
	Within Groups	1172.990	174	6.741		
	Total	1199.339	177			
Empowerment	Between Groups	1.780	3	.593	.106	.956
	Within Groups	973.275	174	5.594		
	Total	975.056	177			
Complexity	Between Groups	5.451	3	1.817	.421	.738
	Within Groups	750.276	174	4.312		
	Total	755.727	177			
Expectation	Between Groups	57.532	3	19.177	7.876	.000
	Within Groups	423.655	174	2.435		
	Total	481.187	177			
WEI	Between Groups	8.984	3	2.995	.523	.667
	Within Groups	995.884	174	5.723		
	Total	1004.868	177			
WPI	Between Groups	28.459	3	9.486	2.153	.095
	Within Groups	766.538	174	4.405		
	Total	794.996	177			
Star Rating	Between Groups	1.732	3	.577	.505	.679
	Within Groups	198.970	174	1.144		
	Total	200.702	177			

The final set of analyses, provided in Table 5.47, consist of a series of one-way ANOVAs conducted on the basis of work ethic. Among these analyses, significant mean differences are indicated in complexity and expectation on the basis of work ethic.

Table 5. 47 (Case Study #4) ANOVAs by Work Ethic

Variable	Measure	Sum of Square	*df*	Mean Square	*F*	*p*
Satisfaction	Between Groups	42.586	3	14.195	1.508	.214
	Within Groups	1638.415	174	9.416		
	Total	1681.000	177			
Comfort	Between Groups	2.938	3	.979	.090	.966
	Within Groups	1897.321	174	10.904		
	Total	1900.258	177			
Productivity	Between Groups	11.547	3	3.849	.498	.684
	Within Groups	1344.793	174	7.729		
	Total	1356.341	177			
Happiness	Between Groups	6.405	3	2.135	.276	.843
	Within Groups	1345.084	174	7.730		
	Total	1351.488	177			
Efficiency	Between Groups	5.230	3	1.743	.254	.858
	Within Groups	1194.109	174	6.863		
	Total	1199.339	177			
Empowerment	Between Groups	7.022	3	2.341	.421	.738
	Within Groups	968.034	174	5.563		
	Total	975.056	177			
Complexity	Between Groups	56.258	3	18.753	4.665	.004
	Within Groups	699.469	174	4.020		
	Total	755.727	177			
Expectation	Between Groups	35.952	3	11.984	4.683	.004
	Within Groups	445.235	174	2.559		
	Total	481.187	177			
WEI	Between Groups	1.649	3	.550	.095	.963
	Within Groups	1003.219	174	5.766		
	Total	1004.868	177			
WPI	Between Groups	21.350	3	7.117	1.601	.191
	Within Groups	773.646	174	4.446		
	Total	794.996	177			
Star Rating	Between Groups	.750	3	.250	.218	.884
	Within Groups	199.952	174	1.149		
	Total	200.702	177			

5.7 Results of Full Sample

The next set of analyses conducted focus upon the full sample of data (i.e. Case Studies #1-4 inclusive). First, a series of Pearson's correlations are conducted to measure of the strength of the association between the two variables and to check for linearity between the measures of satisfaction, comfort, and productivity. The correlation between satisfaction and comfort is found to be positive, moderate, and statistically significant, $r(313) = .478$, $p < .001$. Next, the correlation between satisfaction and productivity is also found to be positive and moderate as well as statistically significant, $r(313) = .311$, $p < .001$. Finally, a positive, moderate, statistically significant correlation is also indicated between comfort and productivity, $r(313) = .403$, $p < .001$.

These same three correlations are conducted a second time as partial correlations, with the effect of complexity being controlled. First, with regard to the correlation between satisfaction and comfort, this is found to be positive, moderate in strength, and statistically significant, $r(310) = .436$, $p < .001$. Next, the correlation between satisfaction and productivity is found to be positive, weak, and significant in these analyses, $r(310) = .267$, $p < .001$, while the correlation between comfort and productivity is found to be positive, moderate in strength, and statistically significant, $r(310) = .377$, $p < .001$. These results indicate that complexity does serve as a moderator with respect to these three associations, though this effect is not very large.

Table 5.48 summarises the results of the regressions conducted incorporating data from all four case studies. In the initial regression analysis conducted, satisfaction is regressed upon comfort. Here, statistical significance is indicated, with a one-unit increase in comfort being associated with a .444 unit increase in satisfaction. The second regression analysis regresses productivity upon satisfaction. Statistical significance is also indicated here, with a one unit increase in satisfaction being associated with a .277 unit increase in productivity. Following this, productivity is regressed upon comfort, with significance also being found. In this analysis, a one unit increase in comfort is found to be associated with a .333 unit increase in productivity. In the fourth linear regression analysis, satisfaction is regressed upon comfort, complexity, and the interaction between comfort and complexity. This analysis indicates statistical significance with regard to the main effects of comfort and

complexity, though not with regard to the interaction between these two items. It is found that a one unit increase in comfort is associated with a .385 unit increase in satisfaction, while a one unit increase in complexity is associated with a .321 unit increase in satisfaction. The fifth regression model regresses productivity upon the main effects of satisfaction and complexity, along with the interaction between these two measures. The results of this analysis indicate significance with respect to the main effect of satisfaction as well as the interaction between satisfaction and complexity. Here, a one unit increase in satisfaction is found to be associated with a .259 unit increase in productivity, while the positive coefficient associated with the significant interaction effect indicated that the effect of satisfaction on productivity is stronger and more positive with higher levels of complexity. Finally, the sixth regression model regresses productivity upon comfort, complexity, as well as the interaction between these two measures. In this model, statistical significance is only indicated with respect to the main effect of comfort. Specifically, a one unit increase in comfort is found to be associated with a .312 unit increase in productivity. All of these regression models are found to achieve statistical significance.

Table 5. 48 (Full Sample) Regression Analyses

Measure	*B*	*SE*	Beta	*t*	*p*	Tol.	VIF
Satisfaction							
(Constant)	.881	.154		5.727	.000		
Comfort	.444	.046	.478	9.635	.000	1.000	1.000
Productivity							
(Constant)	3.258	.154		21.182	.000		
Satisfaction	.277	.048	.311	5.789	.000	1.000	1.000
Productivity							
(Constant)	3.509	.143		24.602	.000		
Comfort	.333	.043	.403	7.797	.000	1.000	1.000
Satisfaction							
(Constant)	.329	.181		1.821	.070		
Comfort	.385	.045	.415	8.485	.000	.945	1.059
Complexity	.321	.068	.241	4.730	.000	.867	1.153
Comfort*Complexity	.022	.017	.066	1.317	.189	.903	1.107
Productivity							
(Constant)	3.069	.179		17.132	.000		
Satisfaction	.259	.051	.291	5.106	.000	.869	1.151
Complexity	.051	.070	.043	.733	.464	.812	1.231
Satis.*Complexity	.048	.019	.142	2.570	.011	.930	1.075
Productivity							
(Constant)	3.331	.174		19.125	.000		
Comfort	.312	.044	.378	7.137	.000	.945	1.059
Complexity	.093	.065	.079	1.420	.157	.867	1.153
Comfort*Complexity	.018	.016	.058	1.077	.282	.903	1.107

Note. [a]$F(1, 313) = 92.829$, $p < .001$; $R^2 = .229$; [b]$F(1, 313) = 33.511$, $p < .001$; $R^2 = .097$; [c]$F(1, 313) = 60.790$, $p < .001$; $R^2 = .163$; [d]$F(3, 311) = 43.825$, $p < .001$; $R^2 = .297$; [e]$F(3, 311) = 14.322$, $p < .001$; $R^2 = .121$; [f]$F(3, 311) = 21.900$, $p < .001$; $R^2 = .174$.

Following this, further analyses are conducted focusing upon respondent demographics. Table 5.49 summarises the results of a series of one-way ANOVAs conducted with respondent age. Among these analyses, significant differences in satisfaction, happiness, empowerment, expectation, WEI, WPI and star rating are found on the basis of respondent age.

Table 5. 49 (Full Sample) ANOVAs by Age

Variable	Measure	Sum of Square	*df*	Mean Square	*F*	*p*
Satisfaction	Between Groups	131.217	3	43.739	4.703	.003
	Within Groups	2892.184	311	9.300		
	Total	3023.402	314			
Comfort	Between Groups	74.078	3	24.693	2.232	.084
	Within Groups	3440.354	311	11.062		
	Total	3514.433	314			
Productivity	Between Groups	30.210	3	10.070	1.324	.266
	Within Groups	2364.927	311	7.604		
	Total	2395.137	314			
Happiness	Between Groups	98.170	3	32.723	4.216	.006
	Within Groups	2413.846	311	7.762		
	Total	2512.016	314			
Efficiency	Between Groups	48.311	3	16.104	2.391	.069
	Within Groups	2094.665	311	6.735		
	Total	2142.976	314			
Empowerment	Between Groups	72.673	3	24.224	4.200	.006
	Within Groups	1793.843	311	5.768		
	Total	1866.516	314			
Complexity	Between Groups	13.138	3	4.379	.802	.493
	Within Groups	1697.262	311	5.457		
	Total	1710.399	314			
Expectation	Between Groups	217.644	3	72.548	31.124	.000
	Within Groups	724.920	311	2.331		
	Total	942.563	314			
WEI	Between Groups	70.754	3	23.585	4.049	.008
	Within Groups	1811.714	311	5.825		
	Total	1882.468	314			
WPI	Between Groups	172.373	3	57.458	12.528	.000
	Within Groups	1426.306	311	4.586		
	Total	1598.679	314			
Star Rating	Between Groups	15.116	3	5.039	4.340	.005
	Within Groups	361.061	311	1.161		
	Total	376.178	314			

Table 5.50 summarises the results of the ANOVAs conducted with current role. These analyses indicate significant mean differences in satisfaction, comfort, happiness, complexity, expectation and WEI on the basis of the respondent's current role.

Table 5. 50 (Full Sample) ANOVAs by Current Role

Variable	Measure	Sum of Square	*df*	Mean Square	*F*	*p*
Satisfaction	Between Groups	93.286	3	31.095	3.300	.021
	Within Groups	2930.116	311	9.422		
	Total	3023.402	314			
Comfort	Between Groups	141.474	3	47.158	4.348	.005
	Within Groups	3372.959	311	10.846		
	Total	3514.433	314			
Productivity	Between Groups	3.341	3	1.114	.145	.933
	Within Groups	2391.796	311	7.691		
	Total	2395.137	314			
Happiness	Between Groups	116.054	3	38.685	5.021	.002
	Within Groups	2395.962	311	7.704		
	Total	2512.016	314			
Efficiency	Between Groups	35.955	3	11.985	1.769	.153
	Within Groups	2107.020	311	6.775		
	Total	2142.976	314			
Empowerment	Between Groups	28.222	3	9.407	1.592	.191
	Within Groups	1838.294	311	5.911		
	Total	1866.516	314			
Complexity	Between Groups	403.164	3	134.388	31.972	.000
	Within Groups	1307.235	311	4.203		
	Total	1710.399	314			
Expectation	Between Groups	480.105	3	160.035	107.622	.000
	Within Groups	462.459	311	1.487		
	Total	942.563	314			
WEI	Between Groups	52.296	3	17.432	2.962	.032
	Within Groups	1830.172	311	5.885		
	Total	1882.468	314			
WPI	Between Groups	23.875	3	7.958	1.572	.196
	Within Groups	1574.804	311	5.064		
	Total	1598.679	314			
Star Rating	Between Groups	8.233	3	2.744	2.320	.075
	Within Groups	367.945	311	1.183		
	Total	376.178	314			

Following this, a series of ANOVAs are conducted focusing upon the mean differences in these measures on the basis of primary workspace type. As indicated in Table 5.51, significant differences in satisfaction, comfort, happiness, complexity, expectation, WEI, WPI and star rating are found on the basis of the primary workspace type.

Table 5. 51 (Full Sample) ANOVAs by Primary Workspace Type

Variable	Measure	Sum of Square	*df*	Mean Square	*F*	*p*
Satisfaction	Between Groups	86.806	3	28.935	3.064	.028
	Within Groups	2936.596	311	9.442		
	Total	3023.402	314			
Comfort	Between Groups	100.622	3	33.541	3.056	.029
	Within Groups	3413.811	311	10.977		
	Total	3514.433	314			
Productivity	Between Groups	22.752	3	7.584	.994	.396
	Within Groups	2372.385	311	7.628		
	Total	2395.137	314			
Happiness	Between Groups	94.787	3	31.596	4.065	.007
	Within Groups	2417.230	311	7.772		
	Total	2512.016	314			
Efficiency	Between Groups	39.738	3	13.246	1.959	.120
	Within Groups	2103.238	311	6.763		
	Total	2142.976	314			
Empowerment	Between Groups	25.786	3	8.595	1.452	.228
	Within Groups	1840.731	311	5.919		
	Total	1866.516	314			
Complexity	Between Groups	166.359	3	55.453	11.169	.000
	Within Groups	1544.040	311	4.965		
	Total	1710.399	314			
Expectation	Between Groups	197.537	3	65.846	27.486	.000
	Within Groups	745.027	311	2.396		
	Total	942.563	314			
WEI	Between Groups	46.878	3	15.626	2.647	.049
	Within Groups	1835.590	311	5.902		
	Total	1882.468	314			
WPI	Between Groups	52.015	3	17.338	3.486	.016
	Within Groups	1546.664	311	4.973		
	Total	1598.679	314			
Star Rating	Between Groups	11.565	3	3.855	3.288	.021
	Within Groups	364.612	311	1.172		
	Total	376.178	314			

The following series of ANOVAs (shown in Table 5.52) focus upon formal education. Among these analyses, significant differences in the mean level of complexity, expectation and WPI are found on the basis of formal education.

Table 5. 52 (Full Sample) ANOVAs by Formal Education

Variable	Measure	Sum of Square	*df*	Mean Square	*F*	*p*
Satisfaction	Between Groups	4.049	3	1.350	.139	.937
	Within Groups	3019.352	311	9.709		
	Total	3023.402	314			
Comfort	Between Groups	17.774	3	5.925	.527	.664
	Within Groups	3496.658	311	11.243		
	Total	3514.433	314			
Productivity	Between Groups	.647	3	.216	.028	.994
	Within Groups	2394.489	311	7.699		
	Total	2395.137	314			
Happiness	Between Groups	9.789	3	3.263	.406	.749
	Within Groups	2502.228	311	8.046		
	Total	2512.016	314			
Efficiency	Between Groups	2.243	3	.748	.109	.955
	Within Groups	2140.733	311	6.883		
	Total	2142.976	314			
Empowerment	Between Groups	.548	3	.183	.030	.993
	Within Groups	1865.968	311	6.000		
	Total	1866.516	314			
Complexity	Between Groups	108.641	3	36.214	7.031	.000
	Within Groups	1601.758	311	5.150		
	Total	1710.399	314			
Expectation	Between Groups	192.436	3	64.145	26.594	.000
	Within Groups	750.127	311	2.412		
	Total	942.563	314			
WEI	Between Groups	2.589	3	.863	.143	.934
	Within Groups	1879.879	311	6.045		
	Total	1882.468	314			
WPI	Between Groups	62.496	3	20.832	4.217	.006
	Within Groups	1536.183	311	4.939		
	Total	1598.679	314			
Star Rating	Between Groups	.944	3	.315	.261	.854
	Within Groups	375.234	311	1.207		
	Total	376.178	314			

The next set of ANOVAs focus upon annual salary. In Table 5.53, significant mean differences in satisfaction, productivity, happiness, empowerment, complexity, expectation, WEI, WPI and star rating are found on the basis of annual salary.

Table 5. 53 (Full Sample) ANOVAs by Annual Salary

Variable	Measure	Sum of Square	*df*	Mean Square	*F*	*p*
Satisfaction	Between Groups	131.862	2	65.931	7.246	.001
	Within Groups	2675.222	294	9.099		
	Total	2807.084	296			
Comfort	Between Groups	21.006	2	10.503	.941	.391
	Within Groups	3280.064	294	11.157		
	Total	3301.071	296			
Productivity	Between Groups	65.539	2	32.770	4.578	.011
	Within Groups	2104.502	294	7.158		
	Total	2170.042	296			
Happiness	Between Groups	52.668	2	26.334	3.383	.035
	Within Groups	2288.449	294	7.784		
	Total	2341.117	296			
Efficiency	Between Groups	37.098	2	18.549	2.779	.064
	Within Groups	1962.407	294	6.675		
	Total	1999.506	296			
Empowerment	Between Groups	102.714	2	51.357	9.352	.000
	Within Groups	1614.593	294	5.492		
	Total	1717.306	296			
Complexity	Between Groups	41.771	2	20.885	4.663	.010
	Within Groups	1316.926	294	4.479		
	Total	1358.696	296			
Expectation	Between Groups	225.919	2	112.960	97.479	.000
	Within Groups	340.689	294	1.159		
	Total	566.608	296			
WEI	Between Groups	61.048	2	30.524	5.311	.005
	Within Groups	1689.800	294	5.748		
	Total	1750.849	296			
WPI	Between Groups	73.735	2	36.867	8.142	.000
	Within Groups	1331.245	294	4.528		
	Total	1404.980	296			
Star Rating	Between Groups	11.691	2	5.845	5.157	.006
	Within Groups	333.279	294	1.134		
	Total	344.970	296			

The next set of analyses conducted consist of a series of independent-samples t-tests which are run on the basis of respondent gender. Among these analyses, significant mean differences in satisfaction, comfort, happiness, complexity, expectation and WEI are found on the basis of respondent gender. Results are provided in Table 5.54.

Table 5. 54 (Full Sample) Independent-Samples t-Test by Gender

Variable	*F*	*p*	*t*	*df*	*p*	Mean Diff.
Satisfaction	2.116	.147	-2.203	313	.028	-0.797
Comfort	3.825	.051	-2.423	313	.016	-0.943
Productivity	1.508	.220	-.380	313	.704	-0.123
Happiness	2.862	.092	-2.755	313	.006	-0.904
Efficiency	1.819	.178	-1.718	313	.087	-0.525
Empowerment	2.398	.123	-1.618	313	.107	-0.461
Complexity	.209	.648	-2.402	313	.017	-0.652
Expectation	2.492	.115	-3.530	313	.000	-0.704
WEI	2.090	.149	-2.212	313	.028	-0.631
WPI	.008	.927	-.196	313	.845	-0.052
Star Rating	.491	.484	-1.770	313	.078	-0.226

Table 5.55, a series of ANOVAs are conducted focusing upon employment in the organisation. Among these analyses, statistical significance is indicated with respect to the measures of satisfaction, comfort, happiness, efficiency, empowerment, expectation, WEI and star rating.

Table 5. 55 (Full Sample) ANOVAs by Employed in Organisation

Variable	Measure	Sum of Square	*df*	Mean Square	*F*	*p*
Satisfaction	Between Groups	237.691	3	79.230	8.845	.000
	Within Groups	2785.711	311	8.957		
	Total	3023.402	314			
Comfort	Between Groups	111.794	3	37.265	3.406	.018
	Within Groups	3402.639	311	10.941		
	Total	3514.433	314			
Productivity	Between Groups	18.951	3	6.317	.827	.480
	Within Groups	2376.186	311	7.640		
	Total	2395.137	314			
Happiness	Between Groups	173.221	3	57.740	7.678	.000
	Within Groups	2338.795	311	7.520		
	Total	2512.016	314			
Efficiency	Between Groups	53.543	3	17.848	2.656	.049
	Within Groups	2089.433	311	6.718		
	Total	2142.976	314			

Empowerment	Between Groups	86.662	3	28.887	5.048	.002
	Within Groups	1779.854	311	5.723		
	Total	1866.516	314			
Complexity	Between Groups	9.881	3	3.294	.602	.614
	Within Groups	1700.518	311	5.468		
	Total	1710.399	314			
Expectation	Between Groups	61.114	3	20.371	7.188	.000
	Within Groups	881.450	311	2.834		
	Total	942.563	314			
WEI	Between Groups	97.354	3	32.451	5.654	.001
	Within Groups	1785.114	311	5.740		
	Total	1882.468	314			
WPI	Between Groups	34.942	3	11.647	2.316	.076
	Within Groups	1563.737	311	5.028		
	Total	1598.679	314			
Star Rating	Between Groups	20.613	3	6.871	6.010	.001
	Within Groups	355.565	311	1.143		
	Total	376.178	314			

Table 5.56 summarises the results of the independent-samples t-tests conducted focusing upon time worked. Among these analyses, significant mean differences are indicated with respect to satisfaction, comfort, happiness, efficiency, empowerment, expectation, WEI, WPI and star rating on the basis of time worked.

Table 5. 56 (Full Sample) Independent-Samples t-Test by Time Worked

Variable	*F*	*p*	*t*	*df*	*p*	Mean Diff.
Satisfaction	.001	.979	4.754	313	.000	2.060
Comfort	1.696	.194	3.974	313	.000	1.876
Productivity	1.644	.201	1.889	313	.060	0.751
Happiness	.997	.319	5.021	313	.000	1.976
Efficiency	5.434	.020	4.033	313	.000	1.306
Empowerment	.278	.599	4.084	313	.000	1.403
Complexity	.097	.755	.249	313	.804	0.084
Expectation	1.407	.237	-2.687	313	.008	-0.666
WEI	2.417	.121	4.548	313	.000	1.560
WPI	.484	.487	-2.317	313	.021	-0.750
Star Rating	4.763	.030	4.573	313	.000	0.668

The following set of ANOVAs focus upon the respondent's main motivation. Among these analyses, significant mean differences are only found with respect to expectation. See Table 5.57 for details.

Table 5. 57 (Full Sample) ANOVAs by Main Motivation

Variable	Measure	Sum of Square	*df*	Mean Square	*F*	*p*
Satisfaction	Between Groups	13.897	3	4.632	.479	.697
	Within Groups	3009.505	311	9.677		
	Total	3023.402	314			
Comfort	Between Groups	68.311	3	22.770	2.055	.106
	Within Groups	3446.121	311	11.081		
	Total	3514.433	314			
Productivity	Between Groups	.582	3	.194	.025	.995
	Within Groups	2394.555	311	7.700		
	Total	2395.137	314			
Happiness	Between Groups	36.759	3	12.253	1.539	.204
	Within Groups	2475.258	311	7.959		
	Total	2512.016	314			
Efficiency	Between Groups	15.745	3	5.248	.767	.513
	Within Groups	2127.231	311	6.840		
	Total	2142.976	314			
Empowerment	Between Groups	3.731	3	1.244	.208	.891
	Within Groups	1862.785	311	5.990		
	Total	1866.516	314			
Complexity	Between Groups	24.924	3	8.308	1.533	.206
	Within Groups	1685.475	311	5.420		
	Total	1710.399	314			
Expectation	Between Groups	92.771	3	30.924	11.317	.000
	Within Groups	849.793	311	2.732		
	Total	942.563	314			
WEI	Between Groups	14.415	3	4.805	.800	.495
	Within Groups	1868.054	311	6.007		
	Total	1882.468	314			
WPI	Between Groups	27.875	3	9.292	1.840	.140
	Within Groups	1570.804	311	5.051		
	Total	1598.679	314			
Star Rating	Between Groups	2.809	3	.936	.780	.506
	Within Groups	373.369	311	1.201		
	Total	376.178	314			

Table 5.58 provides the final set of analyses, consisting of a series of one-way ANOVAs conducted on the basis of work ethic. Among these analyses, significant mean differences are indicated in complexity, expectation and WPI on the basis of work ethic.

Table 5. 58 (Full Sample) ANOVAs by Work Ethic

Variable	Measure	Sum of Square	*df*	Mean Square	*F*	*p*
Satisfaction	Between Groups	74.237	3	24.746	2.610	.052
	Within Groups	2949.165	311	9.483		
	Total	3023.402	314			
Comfort	Between Groups	3.689	3	1.230	.109	.955
	Within Groups	3510.743	311	11.289		
	Total	3514.433	314			
Productivity	Between Groups	2.386	3	.795	.103	.958
	Within Groups	2392.751	311	7.694		
	Total	2395.137	314			
Happiness	Between Groups	13.821	3	4.607	.574	.633
	Within Groups	2498.195	311	8.033		
	Total	2512.016	314			
Efficiency	Between Groups	.525	3	.175	.025	.995
	Within Groups	2142.451	311	6.889		
	Total	2142.976	314			
Empowerment	Between Groups	23.572	3	7.857	1.326	.266
	Within Groups	1842.945	311	5.926		
	Total	1866.516	314			
Complexity	Between Groups	94.375	3	31.458	6.054	.001
	Within Groups	1616.024	311	5.196		
	Total	1710.399	314			
Expectation	Between Groups	64.893	3	21.631	7.665	.000
	Within Groups	877.671	311	2.822		
	Total	942.563	314			
WEI	Between Groups	7.251	3	2.417	.401	.752
	Within Groups	1875.217	311	6.030		
	Total	1882.468	314			
WPI	Between Groups	56.004	3	18.668	3.763	.011
	Within Groups	1542.674	311	4.960		
	Total	1598.679	314			
Star Rating	Between Groups	2.594	3	.865	.720	.541
	Within Groups	373.584	311	1.201		
	Total	376.178	314			

5.8 Four-quadrant Model Test

The four-quadrant model test (also referred to as RP#1 test) yields the following percentages of respondents that have a WEI and WPI falling within Quadrant Q1. The target is 75% for the workplace to be considered 'healthy':

1) *Pilot:* 83.33% (pass test)
2) *Case Study #1:* 44.74% (fail test)
3) *Case Study #2:* 46.88% (fail test)
4) *Case Study #3:* 65.52% (fail test)
5) *Case Study #4:* 62.36% (fail test)
6) *Full Dataset:* 56.83% (fail test)

Overall, research proposition RP#1 was not demonstrated from the case studies, indicating that all observed workplaces have significant issues that need to be addressed. In other words, while 75% of respondents in Q1 indicates that WEI and WPI are both positive, a significant proportion fell in the other quadrants, suggesting that one or both of these indices are negative.

Details are provided in Appendix 3.

5.9 Summary of SEM Analysis

Structured equation modelling (SEM) is essentially an analysis of covariance that can help to test hypotheses and the relationships between variables. This analysis is undertaken using a matrix structure of suspected interactions. In this study it is posited that comfort affects both satisfaction and productivity, and satisfaction also affects productivity. SEM can help to derive unbiased estimates for the relationship between latent constructs using a system of simultaneous regression equations. It is performed here using AMOS in SPSS. However, AMOS (Analysis of Moment Structures) is an add-on module for SPSS. It is designed primarily for structural equation modelling, path analysis, and covariance structure modelling, though it may be used to perform linear regression analysis and ANOVA and ANCOVA.

Figure 5.8 presents the path model used with these analyses. Here, comfort is specified to have a direct effect on productivity, with direct effects also specified between comfort and satisfaction, as well as between satisfaction and

productivity. Therefore, this path diagram also models an indirect effect of comfort on productivity through satisfaction, which is acting as a mediator in this model.

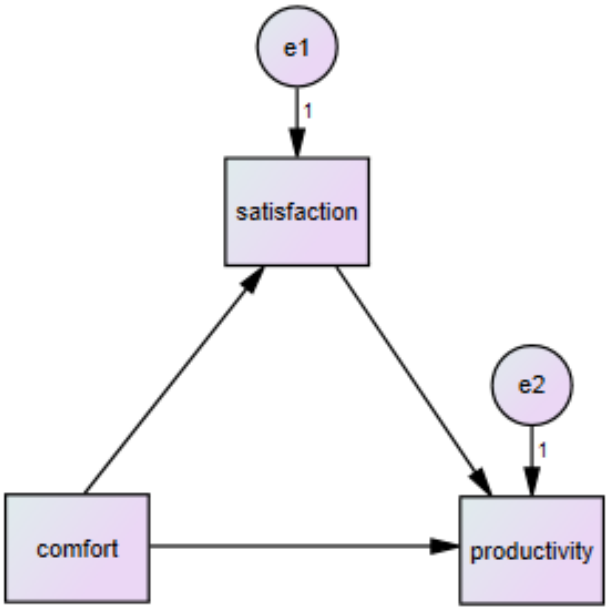

Figure 5. 1 Structured Equation Model
Source: author

Table 5.59 summarises the results of these analyses. The figures reported consist of the estimates (path coefficients), along with their associated standard errors, critical ratios, and levels of significance. First, with regard to Case Study #1, significant, positive effects are found in all cases, that also serves to indicate an important indirect effect of comfort on productivity through satisfaction. In the analysis conducted on the Case Study #2 data, significance is only found with respect to the effect of comfort on satisfaction, as well as the effect of satisfaction on productivity. In both cases, positive estimates are found. These results also serve to indicate an important role of satisfaction as a mediator between comfort and productivity. Next, the analysis conducted on Case Study #3 data finds statistical significance only with respect to the relationship between comfort and satisfaction, which was positive. Finally, in the analysis conducted on Case Study #4 data, significance is found with respect to the effect of comfort on satisfaction as well as the effect of comfort on productivity, which are both positive.

Additionally, with regard to model fit, this model had degrees of freedom of zero, with the measures of model fit therefore artificially indicating perfect fit.

Table 5. 59 Summary of SEM Analysis

Path	Estimate	*SE*	*CR*	*p*
Case Study #1				
Comfort→Satisfaction	.431	.076	5.663	<.001
Satisfaction→Productivity	.270	.105	2.584	.010
Comfort→Productivity	.197	.082	2.390	.017
Case Study #2				
Comfort→Satisfaction	.507	.161	3.146	.002
Satisfaction→Productivity	.627	.160	3.918	<.001
Comfort→Productivity	-.134	.165	-0.815	.415
Case Study #3				
Comfort→Satisfaction	.463	.154	3.012	.003
Satisfaction→Productivity	.206	.196	1.048	.295
Comfort→Productivity	.282	.184	1.532	.126
Case Study #4				
Comfort→Satisfaction	.423	.063	6.700	<.001
Satisfaction→Productivity	.021	.068	.303	.762
Comfort→Productivity	.352	.064	5.473	<.001

SE = standard error

CR = critical ratio

p = level of significance

In summary, this chapter has reported a large number of statistics and related analysis from four different case studies – starting with the response rates and sample size of the presented case study before moving on to explain the key descriptive statistics. This is followed by a series of tables that report all scale measures, along with WEI, WPI and star rating. The chapter concluded with the SEM model that helped to understand and test the hypothesis and explained the relationship between the variables in the study.

CHAPTER 6:
Discussion

This chapter focuses on discussion and interpretation of the research results, which link back to what others have found and reported in the literature. It also addresses what can be learnt from the case studies and why some case cases have stronger hypothesis correlations than others.

This chapter provides research discussion on the thesis topic of workplace ecology. Section 6.1 provides the discussion of the findings and then Section 6.2 focuses on the hypotheses of the research, links findings back to previous research by others, and addresses both research propositions.

6.1 Discussion of the Findings

The aim of this study was to provide a new framework relating to the role of environmental auditing on assets in Australia in the context of climate change and the increasing importance of sustainability. Specifically, this study focused on creating a novel model of environmental auditing related to office space by focusing on statistics relating to workplace ecology. It is intended that this new model for environmental auditing with new criteria will assist in measuring environmental performance for the purposes of reducing or mitigating negative impacts and maximizing the positive responses by organisations. This study also sought to contribute to the establishment of the importance of environmental audits as a method of POE.

First, with regard to Case Study #1, positive, strong, and statistically significant correlations were found between satisfaction and comfort, with

moderate correlations being indicated between satisfaction and productivity as well as comfort and productivity. Additionally, the results of the partial correlations indicated minimal to no moderation with respect to the effect of job complexity. The regression analyses conducted indicated significance with respect to the effects of comfort on satisfaction, satisfaction on productivity, and comfort on productivity, though indicated significant moderation only with respect to the effects of satisfaction and complexity on productivity.

With regard to Case Study #2, a positive, statistically significant, and strong correlation was found between satisfaction and productivity, with a borderline strong correlation found between satisfaction and comfort, and a weak, non-significant correlation between comfort and productivity. The results of the partial correlations indicated that job complexity served as a somewhat important moderator in terms of these relationships. With regard to the regression analyses conducted, significant effects were found for comfort on satisfaction, satisfaction on productivity, though not with regard to comfort on productivity. Additionally, no significant effects of moderation were found in these analyses.

With regard to Case Study #3, a positive, significant, and borderline strong correlation was found between satisfaction and comfort, with moderate and significant to borderline significant correlations found between satisfaction and productivity as well as comfort and productivity. The results of the partial correlations indicated that job complexity served as an important moderator with regard to these relationships. Following this, among the regression analyses conducted, statistical significance was indicated with respect to the effects of comfort on satisfaction, and comfort on productivity, though not with regard to satisfaction on productivity. No significant moderating effects were found.

With regard to Case Study #4, moderate, positive, and significant correlations were found between satisfaction and comfort as well as between comfort and productivity, with a weak correlation indicated between satisfaction and productivity. The partial correlations also indicated weak moderation with respect to the effect of job complexity on these relationships. Following this, the results of the regression analyses indicated significant effects of comfort on satisfaction, satisfaction on productivity, and comfort on productivity.

Additionally, significant moderation was indicated, though only with respect to the moderating effect of complexity on the relationship between satisfaction and productivity.

Finally, a set of analyses were conducted incorporating the full dataset. The correlations conducted indicated significant, positive, and moderate correlations between satisfaction and comfort as well as between comfort and productivity, with a weak correlation found between satisfaction and productivity. The results of the partial correlations also indicated a small moderating effect from job complexity. With respect to the regression analyses, significant effects were found for comfort on satisfaction, satisfaction on productivity, and comfort on productivity. Additionally, in these analyses, a significant moderating effect of job complexity was found with respect to the association between satisfaction and productivity.

In regard to 'organisation' and the measurement of satisfaction, Baum & Amburgey (2002) state that the goal of organisational ecology is to describe the way economic, social and political conditions influence the relative abundance and diversity of organisations and to explain the changes in their structure as time progresses (Abbott *et al.*, 2013). Comparing this study with previous findings, Kinnie *et al.,* (2005) found a link between employees' satisfaction with HR practices and employee commitment to the organisation by using data collection that examined these links for three groups of employees: professionals, line managers and workers. Satisfaction with some HR practices appeared to be linked to the commitment of all employees, while the link for others varied between the three employee groups. This appears in line with what has been studied by Wagner *et al.* (2007) in relation to comfort and workplace occupant satisfaction.

In regard to 'space' and the measurement of comfort, Andrew *et al.* (2008) found that office space has a huge impact on the performance and efficiency of individuals. According to Schneider (2007), a better designed office setting can improve organisational productive by as much as 21%. Mawson (2002) concluded that the increasing importance of the knowledge base of the economy is making it more difficult to determine worker efficiency and so the latter is not taken into account when creating the design for new office space.

In regard to 'technology' and the measurement of productivity, businesses are able to react quickly to market changes through technology provision (Lai, 2011). However, technology can be used by businesses to share information sources. In this way, managers are able to access Internet-based schedules by which a meeting time that is suitable for all members of the working team could be selected (Bresnahan *et al.,* 2002; Autor *et al.,* 2003).

So what does this mean in terms of generalising relationships? Each case study has slightly different outcomes, and perhaps only the full dataset can be used to draw conclusions. What we can learn from the full dataset is that H1-H3 are all supported and significant, although H1 and H2 display moderate correlation while H3 was weaker. Job complexity was shown to have a significant moderating effect on H3 in particular, and H4 was generally supported.

A review of these results indicates substantial differences in the strength of the correlations between the primary measures of interest: satisfaction, comfort and productivity. With regard to Hypothesis H1 (comfort and satisfaction), this correlation was found to be strongest for Case Study #1 data, followed by Case Study #3, Case Study #2, and finally Case Study #4, though the differences in the strengths of these correlations was not very large. However, these results may suggest that the association between comfort and satisfaction is highest in green buildings, and lower in medium quality non-green buildings such as Case Study #4. With respect to Hypothesis H2 (satisfaction and productivity), these results indicated a strong, statistically significant correlation for Case Study #2 data, a moderate to strong correlation for Case Study #1, a weak correlation for Case Study #4, and a non-significant correlation with respect to the Case Study #3. These results may suggest the strongest correlation between satisfaction and productivity occurs in low quality non-green buildings, but weaker in high quality non-green buildings. With regard to Hypothesis H3 (comfort and satisfaction), moderate, significant correlations were found in Case Study #1, Case Study #3, and Case Study #4, with no significant effect found with regard to Case Study #2. This may suggest a stronger positive correlation between comfort and satisfaction in higher quality buildings, with minimal to no effect in lower quality buildings.

Finally, Hypothesis H4 focused upon whether the relationships between satisfaction, comfort, and productivity are moderated by job complexity. This was tested through the use of the partial correlations as well as the interaction effects incorporated into the regression analyses conducted. First, with respect to the partial correlations, these results indicated job complexity being an important moderator with respect to Case Study #3 data, a somewhat important moderator with respect to Case Study #2 data, and with minimal to no moderation indicated with respect to Case Study #4 and Case Study #1 data. These results may suggest job complexity is a more important moderator in high quality non-green buildings, and of lesser importance in green buildings.

Overall then, the results of the analyses indicated strong support for H1-H3 and limited support for H4. Important associations between comfort and satisfaction, satisfaction and productivity, and comfort and productivity were indicated, in general, across all building typologies, while a review of these results also indicated the failure of the high performance green building to set itself apart in any meaningful way from the three non-green buildings included within this study. This was found to be the case with regard to the correlations, partial correlations, along with the sets of regression analysis conducted serving to test H1-H4.

This is not a resounding success story for green buildings. However, it should be kept in mind that this is just one instance. The pilot study, although small, suggests that high performance green buildings can be distinctive, yet achieving good results is not guaranteed. Case Study #1 had such a high degree of dissatisfaction relating to comfort to suggest that this building was an example of an unsuccessful green design.

Finally, an analysis of these results indicate that besides green versus non-green status and building quality, there may be other important factors influencing these generally minor differences in results across these four buildings. There may be other geographical or local socio-demographic reasons explaining these discrepancies, or other factors relating to the specific locality of each of these buildings that may be influencing these results (Voas & Williamson, 2000). Additionally, it may also simply be the case that random variation is partially or largely responsible for these differences found between

the four data sets. Future research could help account for this through the use of a further exploration to help identify which factors are most likely to be influencing these results, and then measuring and controlling for these factors in future research. Additionally, a qualitative component of future research may also be helpful, incorporating in-depth interviews, in order to further understand the relationship between comfort, satisfaction and productivity, along with the moderating effect of job complexity on these relationships.

6.2 Hypothesis Discussion

Table 6.1 shows a summary of the main result that was found during the SPSS analysis. The summary table provides previously explained statistical information in order to highlight the main results. The information is based on the four reported case studies. While these results are encouraging, no clear consensus was found between them. This implies that each case has its own strengths and weaknesses that can influence the outcome.

Table 6. 60 Overall Findings (regression)

Hypothesis	CS #1	CS #2	CS#3	CS#4
H1 (comfort v satisfaction)	**r(74) = .547 p<.001**	r(30) = .492 p<.01	r(27) = .495 p<.01	r(176) = .450 p<.001
H2 (satisfaction v productivity)	r(74) = .460 p<.001	r(30) = .583 p<.001	r(27) = .353 **no signif.**	r(176) = .450 P<.01
H3 (comfort v productivity)	r(74) = .449 p<.001	r(30) = .184 **no signif.**	r(27) = .401 P<.05	r(176) = .427 p<.001
H4 (comfort v satisfaction)	r(71) = .548 p<.001	r(27) = .300 **no signif.**	r(24) = .289 **no signif.**	r(173) = .415 p<.001
H4 (satisfaction v productivity)	r(71) = .444 p<.001	r(27) = .480 p<.01	r(24) = .308 **no signif.**	r(173) = .170 p<.05
H4 (comfort v productivity)	r(71) = .446 p<.001	r(27) = -.098 **negative, no signif.**	r(24) = .364 **no signif.**	r(173) = .409

With regard to the relationship between satisfaction and productivity (the focus of H2), a minimal amount of previous literature was identified focusing upon this relationship. One study was conducted by Kruk (1989), which found a positive association between comfort and productivity, corroborating the

results found in the present study. In his study, it was found that the use of more comfortable, well-designed chairs increased the performance of employees by 27%, while well-defined office furniture (e.g. well setup in the right direction and place) increased employee performance by 15.4%. Additionally, it is suggested that productivity levels increase along with the improvement in office design (Heerwagen, 2000). Specifically, five factors were identified as affecting the productivity levels of workers, consisting of privacy, distractions, flexibility of space and customisation, aesthetics, and access to resources and people.

H3 posited a positive relationship between comfort and productivity. It has been suggested that as would be expected, employees who tend to be happier also perform better in their jobs (Schwede *et al.,* 2008). Furthermore, individuals tend to become more focused after a change or upgrade (Adair, 1984). Previous studies have also documented many cases in which employee performance increases due to positive changes in environmental aspects relating to their workplace. Improving lighting and acoustics was found by Browning (1997) to significantly improve performance in employees at a post office, while a study by Roelofsen (2002) also found an improvement in performance when the indoor ambience of an office was improved. It has also been suggested that illnesses and absenteeism are lower in office buildings that control ventilation and temperature, with higher productivity also evidenced in such buildings (Preller *et al.,* 1990; Brager & deDear, 1998; Hedge *et al.,* 1995; Heerwagen, 2000; Veitch & Newsham, 1998; Wargocki *et al.,* 1999). A number of previous studies have also established an association between discomfort in the sense of air quality, lighting, and similar environmental factors and discomfort or illnesses, which would suggest a direct relationship between discomfort and reduced productivity (Boyce, 1998; Fisk & Rosenfeld, 1997; Heerwagen, 2000; Valbjorn *et al.,* 1995). Similarly, more positive environmental conditions such as the presence of daylight within work environments are associated with positive moods and stress reduction, which would further support the relationship between comfort and productivity (Heerwagen, 2000; Kaplan, 1992). The results of the analyses conducted in this current study in relation to H3 found moderate support for the hypothesis.

Previous research along with a number of additional studies reviewed also strongly corresponded with H1, which focused upon the relationship between comfort and satisfaction. For example, one study found an improvement in mood, room appraisal, environmental satisfaction, and self-assessed productivity was gained through the introduction of lighting dimming controls (Veitch & Newsham, 2000). In addition, a strong and direct relationship between the employee environment and employee satisfaction has also been identified (Carlopio, 1996). In this present study, a fair degree of support was found for H1. Therefore, a moderate degree of similarity was found between the results of this study and previous literature with regard to the association between employee comfort and satisfaction.

Finally, H4 posited that the relationships between satisfaction, comfort and productivity are moderated by job complexity. It has been said that simpler jobs, or jobs of lower complexity, provide a level of responsibility and work that are substantially reduced, which goes on to lower the importance of environmental factors such as exposure to noise, with performance, for example, affected less by noise. In the same way, complex jobs provide a greater level of exposure to noise and also produce increased stress in employees, which serves to decrease work performance within these complex jobs (Melamed *et al.,* 2001). Exposure to noise alongside mental work has been found to increase blood pressure as the level of noise increases (Melamed *et al.,* 2001). In this study, job complexity was modelled as a moderator in sets of three regression analyses conducted in relation to each set of data. These analyses found some support for the role of job complexity as a moderator, though this fourth hypothesis was not strongly supported based on the results found. Therefore, the results of this study are less in line with previous literature as compared with the first three hypotheses.

The two research propositions were also illuminating. RP#1 was not found to be true for the four cases studies, but nevertheless outlines a likely benchmark for attaining a balanced workplace ecosystem. RP#2 was supported, with positive relationships found that are statistically significant but of varying strength. Overall there is a suggestion that the relationship between comfort and satisfaction and between comfort and productivity are of moderate strength, adding weight to common arguments like successful green

buildings lead to happier and more productive workers (Hoel *et al.*, 2011). However, the flow-on effects of healthier workers (i.e. reduced absenteeism) were not tested in this study, given they lend themselves to quantitative independent assessment.

In summary, workplace ecology is a term that describes the conditions present in an office environment that are conducive to happiness, efficiency and empowerment. Combining these three factors provided us with an indicator of workplace ecology, which has been computed as an average for all respondents and helped identify possible areas of improvement. Furthermore, the provided data in Chapter 5 has shown important correlations between the three variables and may suggest data was influenced by the type of office setting (given that each case study was for a different building typology).

The WEM framework with the new criteria and learning circle has assisted in enhancing environmental performance and business performance through a better understanding of the interrelationships between the WEM concepts which will ensure a more holistic approach in assessing workplace environments. The model has been tested through a survey on office buildings in order to determine if the new components helped to deliver better outcomes and reduce environmental risks. At the very least, the use of this model identifies areas of under-performance and therefore provides an opportunity to rectify these problems quickly. Indeed, this is the ultimate objective of any audit.

The aim of this study was to provide a new framework relating to the role of environmental auditing for built assets in Australia in the context of climate change and the increasing importance of sustainability. This chapter provided discussion of research findings for the thesis topic of workplace ecology. The chapter explored the data analysis and interpretation in the context of the literature review. The main findings of the investigation are summarised in the following chapter.

CHAPTER 7:
Conclusion

This chapter comprises the conclusion and summary of the work and explains the significance of the study, how the objectives have been achieved, and the limitations or possible bias in the work (and how these were minimised), together with suggestions for further research.

As discussed earlier, offices are supposed to provide the facility and interactions that support office work and therefore generate income and profits for the business. Office design does not necessarily deliver the best environment for maximum productivity and satisfaction, so a process of review and continuous improvement is warranted.

7.1 Rational and Conclusion of the Study

The rationale for carrying out this research was derived from the knowledge uncovered during the literature review. This study therefore contributes to the current body of literature in the presented research area through the use of original data collection along with an appropriate quantitative methodology incorporating inferential statistical tests for the purpose of hypothesis validation. Support was indicated for the four hypotheses included within this study, and while varying degrees of support were found, the results indicate positive relationships between workplace comfort and satisfaction, workplace satisfaction and productivity, and workplace comfort and productivity. Additionally, some support was found for a moderating effect of job complexity on the relationships between satisfaction, comfort, and productivity.

Through the above, the overarching aim of this study therefore has been achieved and tested by the presented method for assessing the performance of office workplace ecosystems in order to implement continuous improvement. The specific objectives set at the outset were: (1) to review the existing literature concerning office workplace performance and evaluation methodologies, (2) to conceptualise a new framework for integrating the key determinants of workplace ecology, (3) to develop a method to assess the performance of office workplace ecosystems, (4) to collect case study data to test the method for a representative range of office building typologies, (5) to analyse data to identify areas of potential improvement and to evaluate and rank overall workplace performance, (6) to test specific research propositions that explore the relationships between key determinants, and (7) to identify implications for practice and further research opportunities.

The WEM framework is tested via field surveys in various office settings in order to learn if the new model helps to deliver better outcomes for all stakeholders. The WEM framework with the new criteria and learning circle will assist in enhancing environmental performance and business performance through a better understanding of the interrelationships between the WEM concepts (e.g. organisation, space, and technology). This will ensure a more holistic approach in assessing workplace environments through applying technically characterised ideas and management strategies via continuous improvement that can avail the effectiveness of any activity over time. WEM is therefore capable of improving the quality and efficiency of the processes involved in built assets over time through regular application.

To summarise, this study contributes to the current body of literature by conducting a series of analyses that indicate moderate to strong support for Hypotheses H1-H3 and minor support for H4. A very substantial result from these analyses was that there is a relationship between these measures as well as the role of job complexity as a moderator between the separate sets of analyses conducted by sample and building type.

7.2 Limitation of the Study

As mentioned above, this study conducting a series of analyses and as a results it was found that large variations in the relationships tested exist by building: this would consist of a limitation of the study and would suggest that further study would be needed in order to fully understand the relationship between these measures and the extent to which the results obtained could be generalised to a larger population. Based on these results, however it may be suggested that there may be other important factors relating to the measures analysed which may account for the differences indicated between datasets. Future studies could attempt to determine, measure, and analyse these measures in order to control for them in order to attempt to produce a set of results more uniform and more generalisable to a larger population.

Another limitation of this study was that it utilised a convenience sample as opposed to a random probability sample. While distinct from the previous limitation discussed, this would suggest that any results obtained could only tentatively be suggested to apply to a larger population. Future studies that were able to use random sampling to achieve a random probability sample would be able to overcome this limitation, with any results obtained from such a study being generalisable to the population from which the sample was drawn. This would serve to increase the external validity of the results found.

7.3 Recommendations for Further Areas of Study

This study focused only on four specific case studies in Australia. Future studies could attempt to examine a larger number of cases, including heritage-listed office buildings, as well as cases in other countries in order to determine whether the results found in this current study as well as the relationships that were hypothesised to exist based on previous literature and theory hold in these circumstances.

A further issue is the aspect of causality. By using a cross-sectional methodology, this study is able to examine the relationships between variables along with potential mediation and moderation, though is not able to determine causality between the measures studied. A future study collecting panel data, or multiple measurements on the same respondent/cases taken over time, would allow for the determination of causality. This would benefit

this area of literature as it could be determined statistically whether workplace comfort in fact has a causal relationship with satisfaction and productivity, and whether workplace satisfaction has a causal relationship with productivity.

This research delivers on all of the objectives listed in Chapter 1. The topic of workplace ecology is shown to be significant, and the development of the new WEM framework informs better understanding of the complex relationships at play. A means of assessing a balanced workplace ecosystem is announced (RP#1) and shown to be achievable (pilot study) although not easy to attain (Case Studies #1-4). The practical implications are also obvious, with a robust survey now available and a procedure for assessing workplace ecology clearly articulated. Commercialisation of the procedure is expected in the near future in conjunction with an industry partner.

Overall, this study contributes to the current body of literature in this area through the use of original data collection along with appropriate quantitative methodologies incorporating inferential statistical tests for the purpose of hypothesis testing. Demonstration of research skills in problem identification, reviewing underpinning literature, establishing a knowledge gap, and proposing a method to address it have all been achieved. Further, and more importantly, a proficiency in statistical analysis (e.g. descriptive, regression, SEM) and what these findings mean has been clearly evidenced. Although more can be done in the future, as described above, a significant contribution to knowledge has been delivered and a viable area for ongoing development and commercialisation has resulted.

Workplace ecology is now an emerging field of study for those interested in creating office environments where people are more likely to be happy, efficient and empowered in their work activities. Needless to say, it is now possible to ensure that continuous process improvement for existing workplaces is able to occur using a systematic and rigorous procedure.

7.4 Final Remarks

There is a significant interest from the public, governments and global organisations in environmental management. This interest is reflected in the improved acceptance of globally recognised environmental management approaches, increased environmental legislative changes, and pressure on

companies to satisfy legislative requirements, as addressed in the research problem for this thesis. The research builds a new framework for integrating the key determinants of workplace ecology and developing a method to assess the performance of office workplace ecosystems.

Further research is needed. The limited number of case studies included in this thesis do not enable generalisation of the relationships to be formed. More testing of the model in the field is required. It is suspected from this work, however, that case studies are likely to reflect unique outcomes based on their design and operation, including aspects of organisational management, spatial configuration and technological capability, and hence may not display generic characteristics.

Also, the way in which ongoing intervention occurs, based on the principle of continuous improvement, needs to be explored in more detail and measured objectively.

This research does provide a basis for ongoing work by others who will follow and contribute to this research domain. Despite past attempts, this field is an emerging one and contains possibilities for office workplace performance to enable better understanding as it develops over time. This may include, for example, wearable technologies by office workers that can continuously monitor their health and activity with a view to providing healthier workplaces into the future.

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APPENDIX 1:

Published Conference Paper

One paper was prepared at the end of my first year of candidature to define the topic of my thesis following a successful Confirmation Panel presentation. The full citation for this paper is:

Abdullah Al-khawaja, Craig Langston, and Brian Purdey. "A new framework for post occupancy evaluation of office buildings" 37th Annual Conference of the Australasian Universities Building Educators Association (AUBEA). Sydney, Australia. Jul. 2012.

Although the research developed further post-publication of this paper, it was pivotal in the translation of the ELAP model into the Workplace Ecology model via the interim assessment model described herein.

A NEW FRAMEWORK FOR POST OCCUPANCY EVALUATION OF OFFICE BUILDINGS

Abdallah Alkhawaja, Craig Langston and Brian Purdey
Mirvac School of Sustainable Development, Bond University, Gold Coast

ABSTRACT

Over the last three decades there has been growing interest and attention placed on sustainability and the contribution made by the built environment. Environmental auditing applied to buildings has largely been concerned with energy/water usage and waste. This paper argues that post occupancy evaluation can be a useful tool in validating the performance of commercial office buildings in terms of key design objectives of human comfort and productivity, from the perspective of building inhabitants. A new assessment framework, with post occupancy evaluation at its heart, is developed based on a double-loop (learning) cycle for continuous process improvement founded on three principles of engagement, accountability, and legitimacy. This framework enables the influence of both human comfort and productivity to be integrated in assessing the real environmental and organisational performance of commercial office buildings.

Keywords: *environmental accountability, environmental legitimacy, environmental proactivity (engagement), post occupancy evaluation.*

INTRODUCTION

In the last three decades, growing interest in sustainable development has led to a focus on attaining more of an ecological balance to ensure continuous long-term development and maintenance of living standards. Furthermore, climate change is one of the greatest environmental challenges facing the world today, with carbon emissions to the atmosphere expected to contribute significantly to the rise of average global temperatures in the years ahead. As is well known, buildings and development provide countless benefits to society, but they also have clear environmental and health impacts. Less obvious perhaps is how built environments impact on occupants, their satisfaction

and performance. There is no viable assessment framework for evaluation and control that enables integrated continuous improvement in both built environment and business performance.

This paper aims to outline an assessment framework that will help explain the relationship between firms and the productivity of those people working in these firms relative to the built form. This is achieved by building a framework for environmental auditing with new criteria and learning cycles that will assist in integrating business and environmental performance. Opportunities for ongoing research based on this framework are then discussed.

LITERATURE REVIEW

Environmental Impact versus Job Satisfaction

Post occupancy evaluation (POE) has typically focused on the physical characteristics of buildings, including their technical compliance with design documentation and with regulatory codes. In the case of green buildings, this logically is extended to encompass environmental performance and impact. The physical issues take prominence over the human issues, so it is not surprising that how well a building functions from the perspective of its occupants and business managers is overlooked.

The Royal Institution of British Architects Research Steering Group (RIBA, 1991, p.191) defined POE as "a systematic study of building in use to provide architects with information about the performance of their designs and building owners and users with guidelines to achieve the best out of what they already have". The basic assertion is that POE is the process of evaluating buildings in a systematic and rigorous manner after they have been built and occupied for some time (Preiser *et al.,* 1988). This process includes "any and all activities that originate out of an interest in learning how a building performs once it is built, including if and how well it has met expectations" (Vischer, 2001, p.23).

In an attempt to integrate environmental impact and job satisfaction, research from the discipline of business and environmental auditing has been used to help construct a new post occupancy evaluation framework. In particular, the ELAP model (Alrazi *et al.,* 2010) described later in this paper has been

employed. The components of their model, namely proactivity, accountability and legitimacy, are reviewed below in the context of their underpinning literature.

Proactivity (Engagement)

Gonzalez-Benito and Gonzalez-Benito (2006, p.88) classify environmental proactivity as improving ecological performance through the voluntary realization of practices and initiatives. They translated the concept of environmental proactivity into three main components, namely planning and organizational practices such as environmental management systems, operational practices and communicational practices, or put in other words, stakeholder 'engagement'.

Ilinitch *et al.* (1998) found that measurement issues are becoming gradually more significant, which explains why the attention paid to a firm's environmental performance by government regulators, shareholders and the general public has increased. They also revealed that while a firm's participation in unpaid conservation programs may be interpreted as a proactive environmental stance, making political contributions to beat ecological legislation at the same time would suggest the opposite. So aspects of performance, the managerial system and stakeholder relations are analogous to environmental proactivity. In a similar vein, Kolk and Mauser (2002) indicated that environmental operational indicators and environmental management indicators symbolize environmental proactivity. Global Environmental Management Initiative (1998) considers environmental proactivity as a 'lead indicator' that is an in-process measure.

Environmental management systems (EMS) have been defined as "formal systems and databases that integrate procedures and processes for the training of personnel, monitoring, summarizing and reporting of specialized environmental performance information to internal and external stakeholders of the firm" (Melnyk *et al.,* 2003, p.332). However, the main purpose for using EMS is to build up, employ, control, organize and observe company environmental activities to accomplish two goals. The first goal is compliance, which means "reaching and maintaining the minimal legal and regulatory standards for acceptable pollution levels for the purpose of avoiding sanctions"

(Sayre, 1996, p.332). For instance, increased costs due to lack of commitment by firms that in turn leads to increased fines. The second goal is waste reduction, which goes beyond compliance and focuses a firm's behaviour on the dramatic reduction of negative environmental impact (Sayre, 1996). Gonzalez-Benito and Gonzalez-Benito (2006) found that companies must develop environmental policies and goals with clear long-term environmental plans, knowledge of their environmental responsibilities, training programs, and performance measurement systems and evaluations.

EMS can be defined as a joint effort of inner exertions that are directed at analysing, evaluating, enforcing and deriving policies (Coglianese & Nash, 2001). Training the workforce regarding ecological topics, building up ecological execution indicators and objectives, enforcing contract-based environmental laws and internal ecological audits are all enlisted within an EMS (Netherwood, 1998). Unlike regulations that impose external constraints on firms, an EMS arises from within a firm and consists of a voluntary self-regulatory structure (Coglianese & Nash, 2001).

Strategic management guides operational practices and holds performance improvement at its core. More importantly, there are three dimensions of strategic management, namely theoretical, empirical and managerial (Cameron & Whetten, 1983a). The test for any strategy is its performance, so performance is the centre of strategic management (Schendel & Hofer, 1979). In order to evaluate various possible options and strategies for a firm's success, managers opt to devise a performance plan (Venkatraman & Ramanujam, 1986).

Similarly, a lot of research has been done on the issues confronted in organizational effectiveness. In the light of Steers (1975), the ability to interpret and understand the work of many researchers is a good way to gain knowledge of the concept of effectiveness in practice. Being critical when evaluating measurement issues will strongly lead towards grasping an understanding of the constructs that underlie them (Cameron & Whetten, 1983b; Steers, 1975). It is argued that constructs like leadership, intelligence and motivation, when measured at a predefined and specific level, lead to very effective organizational assessment (Cameron & Whetten, 1983b).

Measuring the performance of a firm is an in-depth, complicated and continuous process that requires engagement from practitioners and experts from various diversified areas of human resource management, IT, marketing, accounts and so forth. Nonetheless, during recent years some very new and unique approaches for the performance of a firm have been brought to light, such as activity-based costing (Marr & Schiuma, 2003) and shareholders' value (Rappaport, 2000). Introduction of new measurement tools such as the balanced scorecard (Kaplan and Norton, 1992) and tools for assessment like the business excellence model have made an impact in the modern business world.

A number of companies have adopted EMS, and some other companies have gone even further and had their systems certified for the international standard ISO-14001 (Jiang & Bansal 2003). ISO-14001 is "a set of management processes that requires firms to identify, measure, and control their environmental impacts" (Bansal & Hunter, 2003, p.290). ISO-14001 is not a performance standard, it is rather a process-based standard, and indicates that a firm has implemented a management system that documents its pollution features and impacts, and classifies a pollution anticipation process.

Bansal and Hunter (2003) found that there are six steps that need to be followed in order to act in accordance with the ISO-14001 standard: (1) expand environmental policy, (2) classify the firm's activities, products and services that interrelate with the environment, (3) identify legislative/regulatory necessities, (4) identify the firm's precedence with setting the objectives and targets for reducing environmental impacts, (5) adjust the organizational structure to meet those objectives, such as conveying responsibility, training, conversing and documenting, and (6) verify and correct the EMS. These represent communication practices that must be observed.

Accountability

Human beings are severely neglecting the environment. Humans are approaching limits of resource exhaustion and they will possibly face a major

natural crisis in the future. Therefore, ecological accountability should appear as an important activity in averting such a disaster (Shafer, 2006).

Accountability in management is one of the most elusive concepts. Gray *et al.* (1996) found that accountability leads to two sorts of responsibility: the first is responsibility to report and the second is responsibility to act. This means firms should not only focus on environmental responsibility by protecting the natural environment or minimizing negative impacts on the environment, but should also report any efforts undertaken when considering the community.

Environmental accountability emerged from two different concepts, environmental reporting and environmental performance. Hence, in this paper, environmental accountability is the extent to which an entity acts sensibly towards the natural environment and reports on its ecological performance. Accountability theory is focused more on stakeholder issues rather than cleaning up poor business behaviour (Deegan 2006; Gray *et al.,* 1996).

In the late 20th Century, public awareness increased about the impact of technology and expanding human populations. The nations have started to focus their efforts to decrease their ecological impact and buildings have been recognized as major contributors to the world's energy usage, landfill waste and diminishing green space (IFMA Foundation, 2010). Building rating schemes have emerged as a means of guiding the design and operation of more environmentally friendly buildings.

The most popular green rating systems include the Building Research Establishment's Environmental Assessment Method (BREEAM) and Leadership in Energy and Environmental Design (LEED), while Green Star is the most common green rating scheme in Australia. The BREEAM system is perceived as being elastic to local regulations but strict in areas where local regulations are not valid. BREEAM is one of the major green rating schemes in the world and there is a requirement for the assessor to be involved in all stages of the process (Julien, 2009). Green rating schemes are designed to bring accountability to the process of producing high environmental performance buildings.

In much the same way, firms need to be accountable for their management of people. This can be described as the process of planning, putting in order,

orienting and managing the procurement, development, compensation and maintenance of human resource management (Flippo, 1984). In comparison to the cost of the labour, often not more than 10% of a firm's net operating expenses are spent on costs of occupancy (Kaplan & Aronoff, 1996), so employee salaries and related expenses are a significant cost centre.

It is quite normal to support the argument that in an upgraded or new work environment, workers tend to be happier and so they perform better (Schwede, *et al.* 2008). With a change or upgrade, people become more focused. Many examples from real life have been observed in which the performance of the workers have increased due to the positive changes in environmental aspects. A significant 8% increase in the performance of employees at a post office was observed upon the improvement in lighting and acoustics (Browning, 1997). Elsewhere, when indoor ambience was improved, a 10% inclination towards performance followed (Roelofsen, 2002).

Furthermore, a study by Veitch & Newsham (2000) found that a valuable improvement in mood, room appraisal, environmental satisfaction and self-assessed productivity was observed from the introduction of lighting dimming controls. Kruk (1989) gave much importance to the furniture present in the office as he claimed that a comfortable well-designed chair increased the performance of employees by 27%, while well-designed office furniture increased it by 15.4%. If the workplace is full of innovation and creativity than it is reported to attract and retain more and more workers who possess creativity (Haynes and Price, 2004). It is often postulated that there is a direct and strong relationship between employee environment (i.e. comfort) and employee satisfaction (e.g. Carlopio, 1996).

Legitimacy

Legitimacy has been defined as "a generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions" (Suchman, 1995, p.574). However, according to Brønn and Vidaver-Cohen (2009), meeting social expectations is becoming gradually more essential for firms to maintain legitimacy in the public eye, and the changing global

business climate may now require firms to invest in a social program to maintain legitimacy within their organizational fields.

On the other hand, Brønn and Vidaver-Cohen (2009) found that social responsibility can be legitimatized through three main points: image building, altruism and profitability. They also found that the most important consideration related to the legitimacy motives is "improve our image", "be recognized for moral leadership" and "serve long-term company interests". The researchers also recognized that managers need to believe they are responding to these forces significantly by caring for their firm's image, encouraging goodwill among stakeholders and enhancing the reputation of the industry to which the firm belongs. Bertels and Peloza (2006) and Vidaver-Cohen (2007) provided further explanation about legitimacy and reputation enhancement.

Owen (2007) found that social and environmental accounting studies employed a legitimacy theory lens. Mobus (2005) studied employing legitimacy theory as an explanatory tool. He argued that the theory remains immature and using it to make specific predictions is hard. POE is a technique that has developed over the last 50 years to legitimize design via an audit of a building and the opinion of its occupants.

POE has particular advantages for facilities management (Preiser, 1995; Hadjri & Crozier. 2009). Many sources recommend that an essential move in the style of building procurement and practice, mainly inside the client/developer and design communities, is necessary to truly acknowledge the idea of POE and ensuing its benefits are realized (Green and Moss, 1998; Zimmerman and Martin, 2001; Bordass and Leaman, 2005; Hadjri & Crozier, 2009).

CONCEPTUAL FRAMEWORK

The notions of proactivity (engagement), accountability and legitimacy are brought together in the context of an environmental auditing framework (ELAP) in the work of Alrazi *et al.* (2010), and applied to firms. They found that firms should ensure a sensible level of stakeholder satisfaction, which is why they put environmental legitimacy and stakeholder satisfaction in the same group. This involves attention to aspects of environmental accountability from two main concepts, namely environmental reporting and environmental performance. These are achieved through having a proper accounting and

environmental management systems and increasing stakeholder communication and engagement. The ELAP model is shown in Figure A.1.

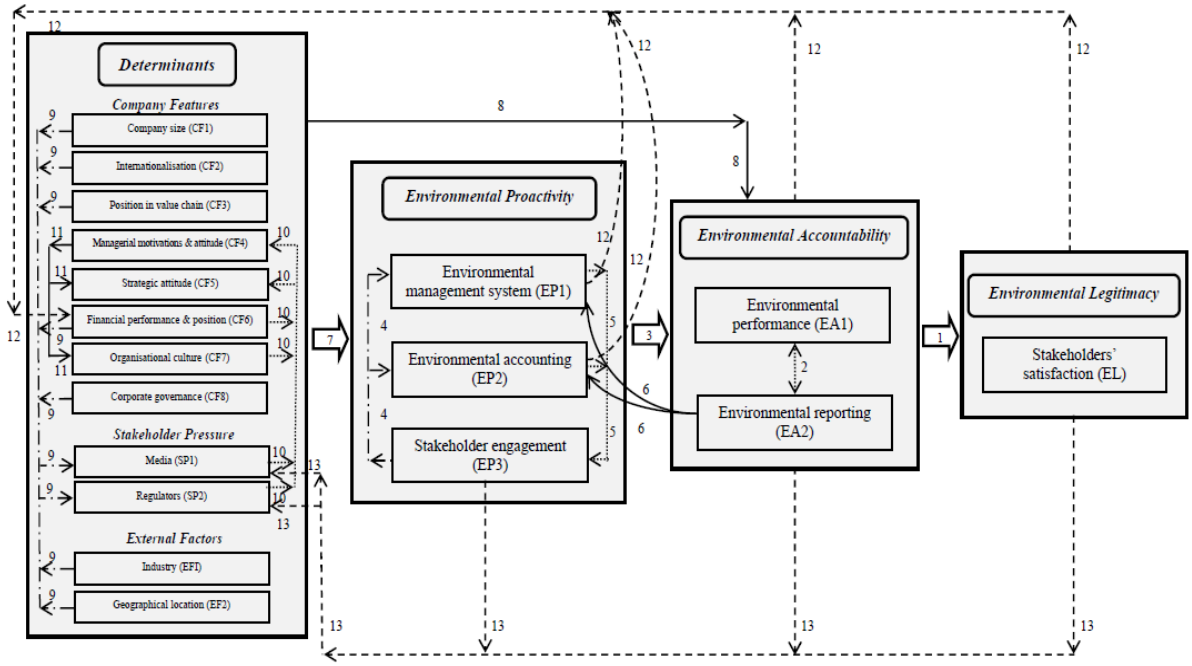

Figure A.1: ELAP Framework for environmental legitimacy, accountability and proactivity (Source: Alrazi et al., 2010)

Total quality management, which is based on the idea of continuous process improvement, has been quite useful for many firms in achieving excellence and quality output. As continuous improvement identifies what changes to make, it provides ingeniously efficient ideas on how to achieve tasks more quickly and systematically increase performance (Zangwill & Kantor, 1998).

Argyris (1976, 2002) explained an approach related to continuous improvement called double-loop learning, or lemniscates, which is a curve with a characteristic shape consisting of two-loops that meet at a central point, as shown in Figure A.2.

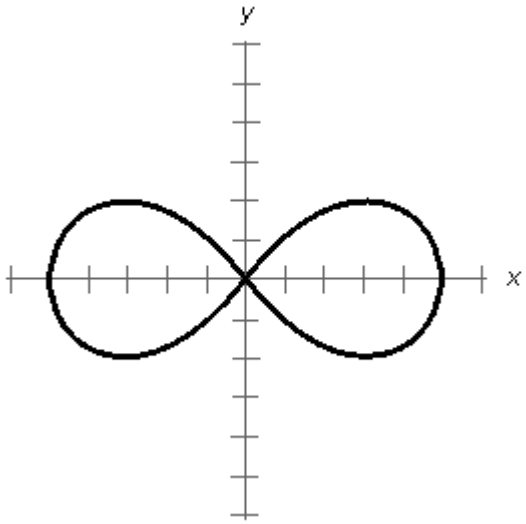

Figure A.2: Double-loop learning (Source: Weisstein, 2011)

An espoused theory of achievement based on single-loop learning is found to be the most general model of action. A double-loop model is postulated as providing more effective feedback and decision-making. Double-loop learning involves not only adjusting one's thinking, but also surfacing, challenging and adjusting the governing variables that are usually taken for granted. To fit the double-loop model into practice, firms should look beyond the familiar methods of approaching the challenge at hand to embrace novel and creative solutions (Argyris, 1977; 2002). A double-loop model adds a powerful dimension to previous experiential learning cycles that focused on reflection of the success (or failure) of organizational actions. However, in double-loop models, learning is understood through reflection on the validity and usefulness of organizational beliefs.

The ELAP framework and the double-loop model have led to an innovative assessment framework for exploring the link between environmental and business performance. Each part of the learning cycle follows the traditional management paradigm of plan-act-review. The upper-loop aims to improve comfort through the procurement of green buildings, and leads to insight into the environmental impact of buildings, while the lower-loop aims to improve productivity through workplace reform, and leads to insight into the job satisfaction of employees. Each one affects the other. The proposed assessment framework is presented for the first time in Figure A.3.

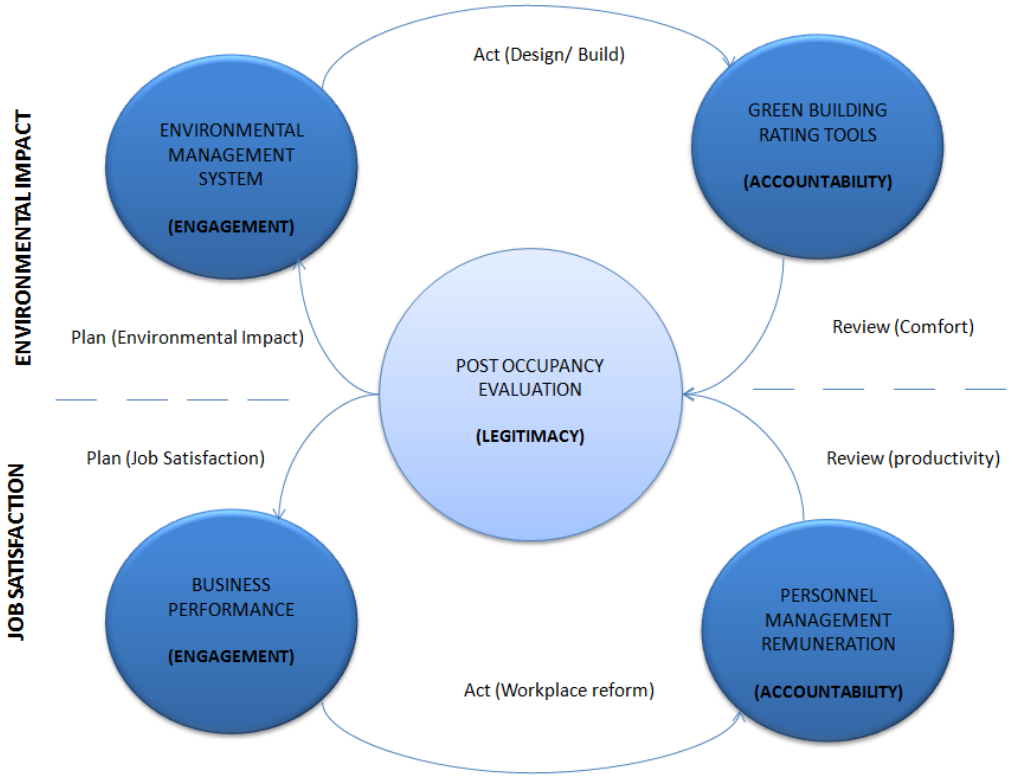

Figure A.3: Proposed assessment framework for built environment engagement, accountability, and legitimacy

The interesting part of the proposed assessment framework is the use of POE as the means of legitimacy. This singular technique is argued to be capable of integrating the assessment of comfort and productivity, and hence providing a means whereby the relationship between them can be better understood. It is acknowledged that improvements in comfort do not automatically lead to improvements in productivity, and for this to occur better knowledge of the connection is required. Employee satisfaction and well-being arguably lie at the nexus of the new framework.

RESEARCH PLAN

The authors plan to test the above assessment framework and validate the SWOT analysis via detailed case studies involving existing buildings that are either traditional modern office space (common practice), heritage-listed traditional office space (past practice), or high-performance green office space (future practice). The focus of the work will centre on the development and testing of a POE tool capable of collecting reliable data about employee comfort

and productivity and ultimately employee satisfaction and well-being so that the relationship between these key variables can be explored in different contexts and better understood.

This research plan will be implemented in 2012 and 2013.

CONCLUSION

This paper describes the development of an assessment framework that integrates legitimacy, accountability and proactivity (engagement), into a double-loop (learning) cycle with POE at its nexus, and plans for its application in practice. This research will help advance our understanding of the link between green building design and corporate business performance, including the underlying motives.

The ultimate question to be answered is whether working in green office buildings may have higher levels of comfort, satisfaction, and performance compared to working in non-green buildings. This question has important implications in regard to the business case for change from non-green to green workspaces, and the wider requirements of climate change adaptation.

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APPENDIX 2:
Online Questionnaire

Data was collected for the four case studies using an online questionnaire constructed and managed via SurveyMonkey™. The actual question, including the ethics consent notice, is provided here.

Explanatory Statement

This survey forms part of a research project on “Engagement, accountability, and legitimacy as a framework for post occupancy evaluation” with BUHREC Protocol Number R01468 by Bond University’s Institute of Sustainable Development and Architecture. The research concerns exploring the relationships between work environment and performance, in particular issues of personal comfort, productivity, job satisfaction and well-being.

Your organization supports this research and has agreed for you to be invited to participate. This online survey should take on average about 10 minutes to complete.

Participation in this research is entirely voluntary and there are no known or anticipated risks to participation in this study. Once the data have been analyzed, your organization will receive a copy of the overall findings. The data you provide will be anonymous and will not be able to be identified by anyone. Your anonymous response will be kept in a secure place for 5 years, and then destroyed.

Should you have any concerns regarding this study, please contact the principal researcher, Professor Craig Langston, at clangsto@bond.edu.au or (617) 5595 2233.

Consent Form

I certify that I am at least 18 years old and that I am willing to participate in the above Bond University research project.

I understand the purpose and objectives of the study, its limits and the risks associated with participation.

I am aware that the information that I will provide along with my identity will be kept confidential and will not be revealed in any written report or to any other party. The information generated from me will only be accessible to the researcher and it will be securely kept at the researcher's office located at Bond University.

I understand that I will be asked to provide opinion on my personal comfort, productivity, job satisfaction and well-being in the context of my physical workspace.

I have read the Explanatory Statement and understand that the information I provide will be de-indentified and anonymous. At any time that I feel uncomfortable, I am aware that I can withdraw from the research without penalty.

Please indicate your consent to proceed

◯ I agree

About me

Please select the appropriate answer

1a What is your age?

- ◯ less than 25
- ◯ 26-40
- ◯ 41-55
- ◯ more than 55

1b What is your gender?

- ◯ female
- ◯ male

2a What is you current role?

- ◯ contractor/casual
- ◯ employee
- ◯ line manager
- ◯ senior manager

2b Employed in organization?

- ◯ less than 1 year
- ◯ 1-10 years
- ◯ 11-20 years
- ◯ more than 20 years

3a Primary work space type?

- ◯ closed cell office
- ◯ open plan office (large group)
- ◯ shared space (small group)
- ◯ activity-based (mobile)

3b Time worked in this space?

- ◯ less than one year
- ◯ more than one year

3c Location of work space?

- ◯ high performance green office building
- ◯ heritage-listed office building
- ◯ other office building
- ◯ non-office building (please specify)

4a What is your formal education?

- ◯ diploma / certificate
- ◯ bachelors degree
- ◯ masters / doctorate
- ◯ none of the above

4b What was your main motivation for study?

- ◯ personal advancement
- ◯ mandatory qualification
- ◯ promotion / remuneration
- ◯ not applicable / other

5a What is your average monthly salary (f/t equiv.):

- ◯ less than $50,000 gross
- ◯ $50,001 - $100,000 gross
- ◯ $100,001 - $150,000 gross
- ◯ more than $150,000 gross

5b What is your dominant work ethic?

- ◯ hard-working
- ◯ reliable
- ◯ creative flair
- ◯ team player

About my job

Please state opinion and relevance

6 My opinion

	strongly disagree				strongly agree
I love my job	◯	◯	◯	◯	◯
I get on well with those in higher positions	◯	◯	◯	◯	◯
I have a good relationship with my immediate work colleagues	◯	◯	◯	◯	◯
I receive generous rewards for my work	◯	◯	◯	◯	◯
I feel appreciated when I do good work	◯	◯	◯	◯	◯
Change in the workplace is generally handled openly	◯	◯	◯	◯	◯
I can easily speak with my supervisor/manager when I need to	◯	◯	◯	◯	◯
I feel engaged with the organisation and its mission	◯	◯	◯	◯	◯
Bullying and harassment in my workplace do not exist	◯	◯	◯	◯	◯
I have opportunities for advancement in the organisation	◯	◯	◯	◯	◯
My work tasks are usually undertaken collaboratively	◯	◯	◯	◯	◯
I regularly have to work extra hours	◯	◯	◯	◯	◯
I am an influential member of a dynamic team	◯	◯	◯	◯	◯
I often need to solve complex problems myself	◯	◯	◯	◯	◯
Effective time management is a critical attribute in my position	◯	◯	◯	◯	◯
I am responsible for the work of others in the organisation	◯	◯	◯	◯	◯
I am a person others frequently come to for help	◯	◯	◯	◯	◯
I spend a lot of time in formal and informal meetings	◯	◯	◯	◯	◯
I am allowed to work at home or offsite at my discretion	◯	◯	◯	◯	◯
I enjoy a job that is challenging albeit stressful at times	◯	◯	◯	◯	◯

7 Relevance to me

	not important				very important
I love my job	◯	◯	◯	◯	◯
I get on well with those in higher positions	◯	◯	◯	◯	◯
I have a good relationship with my immediate work colleagues	◯	◯	◯	◯	◯
I receive generous rewards for my work	◯	◯	◯	◯	◯
I feel appreciated when I do good work	◯	◯	◯	◯	◯
Change in the workplace is generally handled openly	◯	◯	◯	◯	◯
I can easily speak with my supervisor/manager when I need to	◯	◯	◯	◯	◯
I feel engaged with the organisation and its mission	◯	◯	◯	◯	◯
Bullying and harassment in my workplace do not exist	◯	◯	◯	◯	◯
I have opportunities for advancement in the organisation	◯	◯	◯	◯	◯
My work tasks are usually undertaken collaboratively	◯	◯	◯	◯	◯
I regularly have to work extra hours	◯	◯	◯	◯	◯
I am an influential member of a dynamic team	◯	◯	◯	◯	◯
I often need to solve complex problems myself	◯	◯	◯	◯	◯
Effective time management is a critical attribute in my position	◯	◯	◯	◯	◯
I am responsible for the work of others in the organisation	◯	◯	◯	◯	◯
I am a person others frequently come to for help	◯	◯	◯	◯	◯
I spend a lot of time in formal and informal meetings	◯	◯	◯	◯	◯
I am allowed to work at home or offsite at my discretion	◯	◯	◯	◯	◯
I enjoy a job that is challenging albeit stressful at times	◯	◯	◯	◯	◯

About my environment

Please state opinion and relevance

8 My opinion

	strongly disagree				strongly agree
Office air temperature is normally conducive to my work tasks	◯	◯	◯	◯	◯
Indoor air quality/ventilation is excellent	◯	◯	◯	◯	◯
My work space has a good combination of natural and artificial light	◯	◯	◯	◯	◯
I have a clear view of what is going on outside the building	◯	◯	◯	◯	◯
Office noise disturbance is minimal	◯	◯	◯	◯	◯
I have control over my personal comfort settings	◯	◯	◯	◯	◯
I have reasonable visual privacy when working	◯	◯	◯	◯	◯
There are no work space issues that impact negatively on my health	◯	◯	◯	◯	◯
My office furniture is comfortable and adjustable	◯	◯	◯	◯	◯
I have appropriate work and storage space	◯	◯	◯	◯	◯
I have access to the necessary IT services to fulfil my role	◯	◯	◯	◯	◯
All equipment I use in the office is provided by the organisation	◯	◯	◯	◯	◯
I can access the data I need wherever I might be	◯	◯	◯	◯	◯
My work is automatically backed up every day	◯	◯	◯	◯	◯
I use IT extensively to communicate and stay well informed	◯	◯	◯	◯	◯
Prompt IT support is available if I have a problem	◯	◯	◯	◯	◯
Data compatibility and transfer among office staff is straightforward	◯	◯	◯	◯	◯
If I need specialist IT equipment for a particular task it is provided	◯	◯	◯	◯	◯
I consider myself to be an effective user of technology	◯	◯	◯	◯	◯
Use of IT enables me to be more organised and professional	◯	◯	◯	◯	◯

9 Relevance to me

	not important				very important
Office air temperature is normally conducive to my work tasks	◯	◯	◯	◯	◯
Indoor air quality/ventilation is excellent	◯	◯	◯	◯	◯
My work space has a good combination of natural and artificial light	◯	◯	◯	◯	◯
I have a clear view of what is going on outside the building	◯	◯	◯	◯	◯
Office noise disturbance is minimal	◯	◯	◯	◯	◯
I have control over my personal comfort settings	◯	◯	◯	◯	◯
I have reasonable visual privacy when working	◯	◯	◯	◯	◯
There are no work space issues that impact negatively on my health	◯	◯	◯	◯	◯
My office furniture is comfortable and adjustable	◯	◯	◯	◯	◯
I have appropriate work and storage space	◯	◯	◯	◯	◯
I have access to the necessary IT services to fulfil my role	◯	◯	◯	◯	◯
All equipment I use in the office is provided by the organisation	◯	◯	◯	◯	◯
I can access the data I need wherever I might be	◯	◯	◯	◯	◯
My work is automatically backed up every day	◯	◯	◯	◯	◯
I use IT extensively to communicate and stay well informed	◯	◯	◯	◯	◯
Prompt IT support is available if I have a problem	◯	◯	◯	◯	◯
Data compatibility and transfer among office staff is straightforward	◯	◯	◯	◯	◯
If I need specialist IT equipment for a particular task it is provided	◯	◯	◯	◯	◯
I consider myself to be an effective user of technology	◯	◯	◯	◯	◯
Use of IT enables me to be more organised and professional	◯	◯	◯	◯	◯

10 Any other comments you would like to make?

APPENDIX 3:

Pilot and Case Study Summaries

The data collected for the pilot survey and the four subsequent case studies is assembled into purpose-built Excel spreadsheets that compute some of the key relationships as scatterplots. The identity of all participants, and indeed the identity of the four case studies, has been kept confidential as requested by the consenting organisations involved.

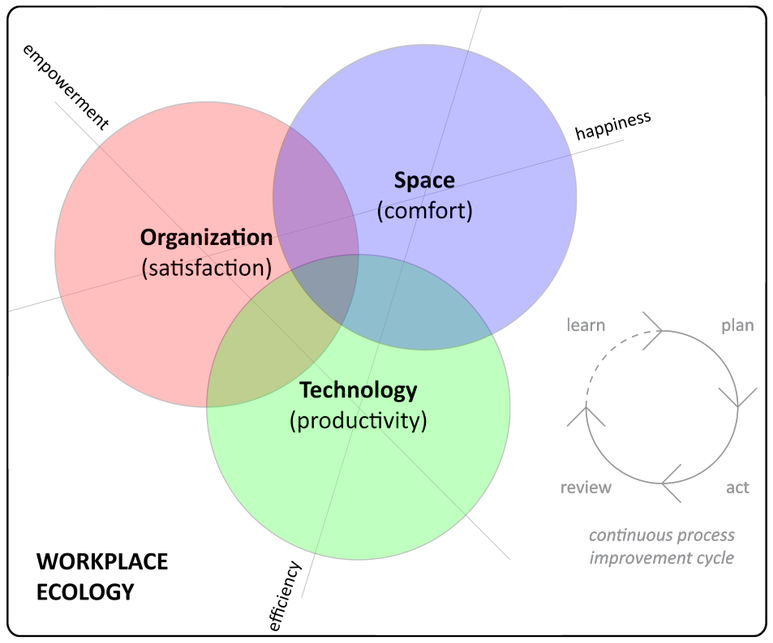
The following pages contain the data summaries, including a full dataset of all the case studies combined together.

SUMMARY ANALYSIS

RESPONSE RATE: 68.57% (minimum 30% required)

SURVEY POPULATION: 35

CONCEPTUAL FRAMEWORK:



AVERAGE OPINION X WEIGHT
N

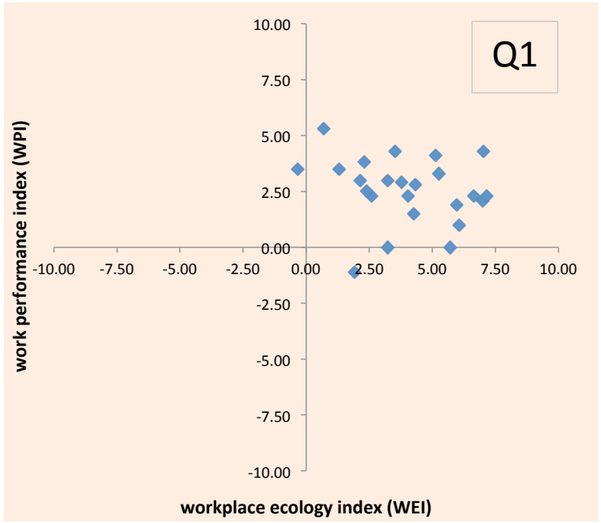
OPINION=1
N

WEIGHTING=5
N

RESEARCH PROPOSITIONS (RP):

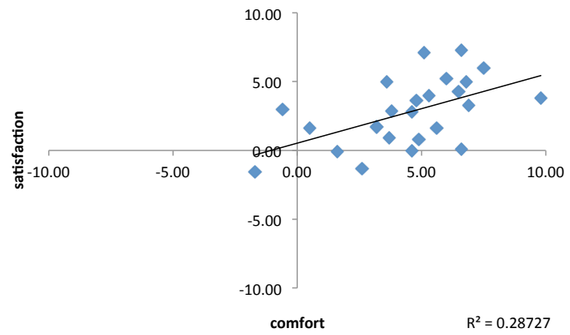
HEALTHY ECOSYSTEMS: *RP #1: at least three-quarters of the values for WEI and WPI must fall within quadrant Q1 for a balanced work 'ecosystem'**

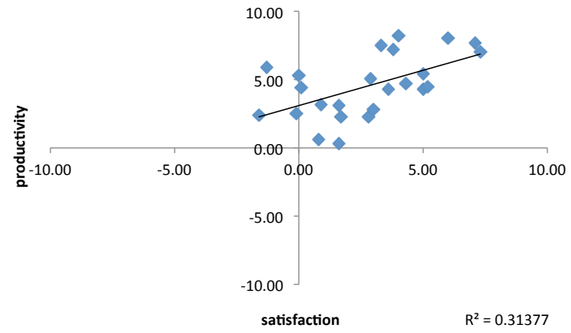
ECOSYSTEM ATTRIBUTES: *RP #2: the components of WEI have a significant positive correlation with each other, moderated by job complexity*

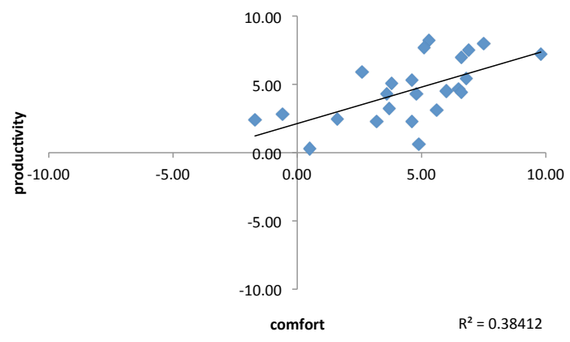


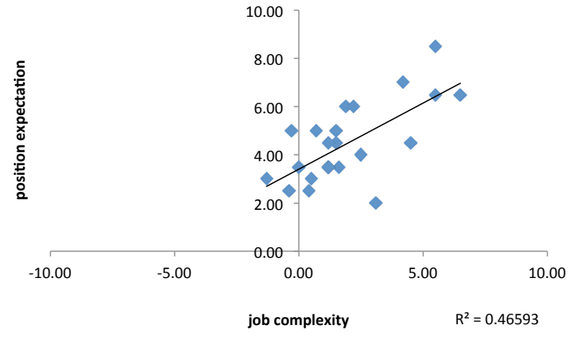
** the ratio of Q1 to Q1-4 can be used to rank the performance of workplaces*

RP #2 TESTS:



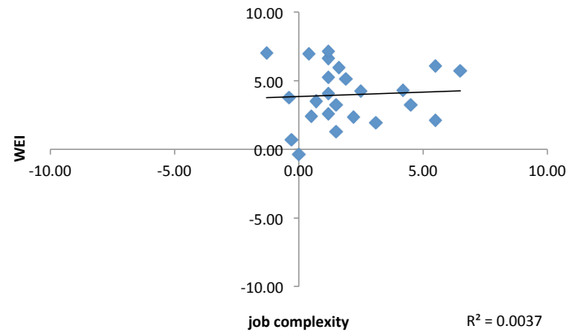


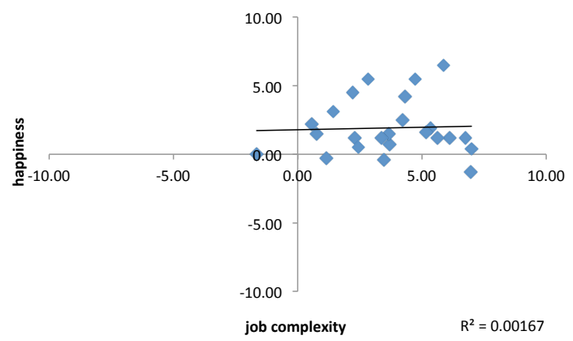


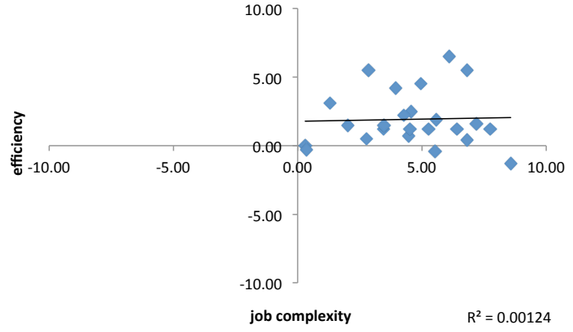


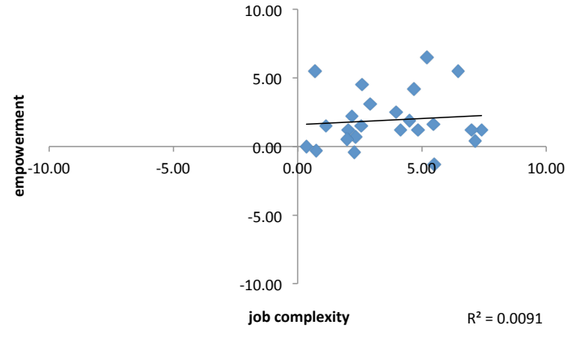
AVERAGE		2.79	4.51	4.54	3.68	4.55	3.67	1.92	4.46	3.97	2.54	83.33%	2.50
												target 75%	
	building type	*satisfaction*	*comfort*	*productivity*	*happiness*	*efficiency*	*empowerment*	*complexity*	*expectation*	*WEI*	*WPI*	*RP #1 test*	*star rating*
1	GREEN	5.00	3.60	4.30	4.31	3.93	4.67	4.20	7.00	4.31	2.80	-1.51	3
2	GREEN	4.30	6.50	4.70	5.35	5.57	4.50	1.90	6.00	5.13	4.10	-1.03	3
3	GREEN	-1.60	-1.70	2.40	-1.65	0.30	0.36	0.00	3.50	-0.34	3.50		0
4	GREEN	0.10	6.60	4.40	3.47	5.53	2.28	-0.40	2.50	3.78	2.90	-0.88	2
5	GREEN	3.80	9.80	7.20	6.96	8.57	5.50	-1.30	3.00	7.04	4.30	-2.74	4
6	GREEN	3.30	6.90	7.50	5.16	7.20	5.47	1.60	3.50	5.95	1.90	-4.05	3
7	GREEN	4.00	5.30	8.20	4.74	6.81	6.47	5.50	6.50	6.06	1.00	-5.06	4
8	GREEN	1.60	5.60	3.10	3.70	4.46	2.32	0.70	5.00	3.51	4.30	0.79	2
9	GREEN	7.30	6.60	7.00	6.99	6.82	7.15	0.40	2.50	6.99	2.10	-4.89	4
10	GREEN	7.10	5.10	7.70	6.12	6.41	7.40	1.20	3.50	6.65	2.30	-4.35	4
11	GREEN	0.00	4.60	5.30	2.20	4.96	2.60	4.50	4.50	3.24	0.00		2
12	GREEN	5.00	6.80	5.40	5.88	6.10	5.20	6.50	6.50	5.72	0.00		3
13	GREEN	0.90	3.70	3.20	2.28	3.45	2.04	1.20	3.50	2.59	2.30	-0.29	2
14	GREEN	2.80	4.60	2.30	3.68	3.47	2.56	1.50	4.50	3.23	3.00	-0.23	2
15	GREEN	0.80	4.90	0.60	2.83	2.85	0.71	5.50	8.50	2.14	3.00	0.86	2
16	GREEN	1.60	0.50	0.30	1.16	0.35	0.75	-0.30	5.00	0.70	5.30	4.60	1
17	GREEN	2.90	3.80	5.10	3.37	4.50	4.15	1.20	3.50	4.04	2.30	-1.74	3
18	GREEN	1.70	3.20	2.30	2.45	2.76	1.99	0.50	3.00	2.40	2.50	0.10	2
19	GREEN	-0.10	1.60	2.50	0.76	2.02	1.13	1.50	5.00	1.29	3.50	2.21	1
20	GREEN	6.00	7.50	8.00	6.74	7.75	6.99	1.20	3.50	7.16	2.30	-4.86	4
21	GREEN	3.60	4.80	4.30	4.23	4.56	3.95	2.50	4.00	4.25	1.50	-2.75	3
22	GREEN	5.20	6.00	4.50	5.62	5.28	4.85	1.20	4.50	5.25	3.30	-1.95	3
23	GREEN	3.00	-0.60	2.80	1.43	1.30	2.90	3.10	2.00	1.92	-1.10		1

24	GREEN	-1.30	2.60	5.90	0.56	4.27	2.18	2.20	6.00	2.31	3.80	1.49	2







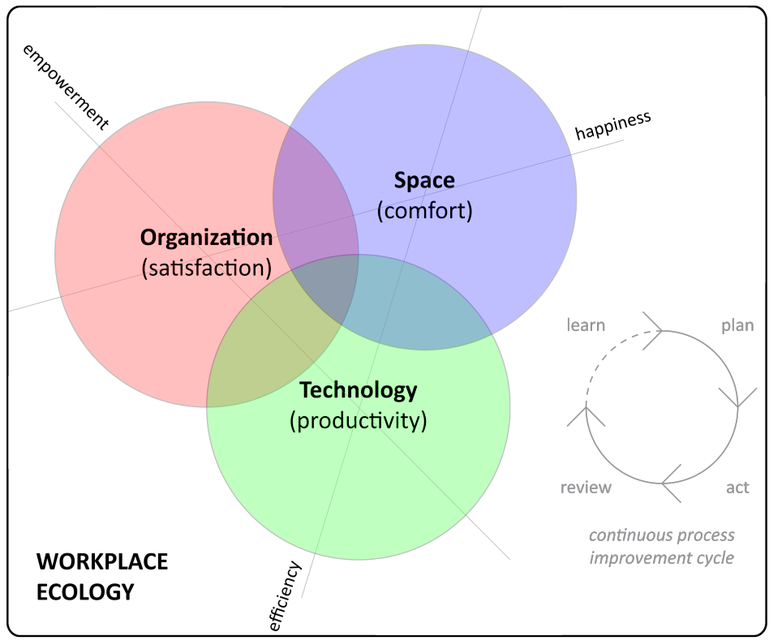


SUMMARY ANALYSIS

RESPONSE RATE: 33.04% (minimum 30% required)

SURVEY POPULATION: 230

CONCEPTUAL FRAMEWORK:



AVERAGE OPINION X WEIGHT
N

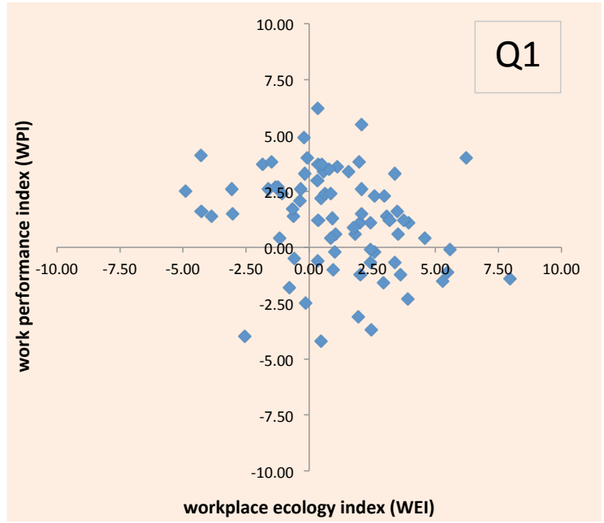
OPINION=1
N

WEIGHTING=5
N

RESEARCH PROPOSITIONS (RP):

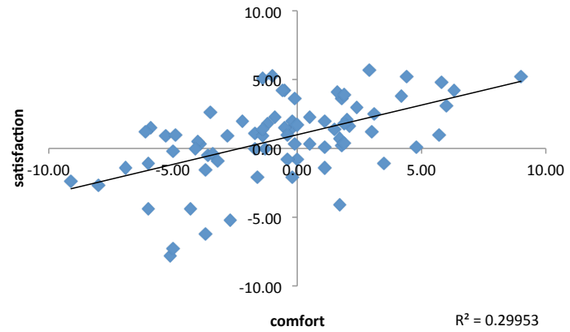
HEALTHY ECOSYSTEMS: *RP #1: at least three-quarters of the values for WEI and WPI must fall within quadrant Q1 for a balanced work 'ecosystem'**

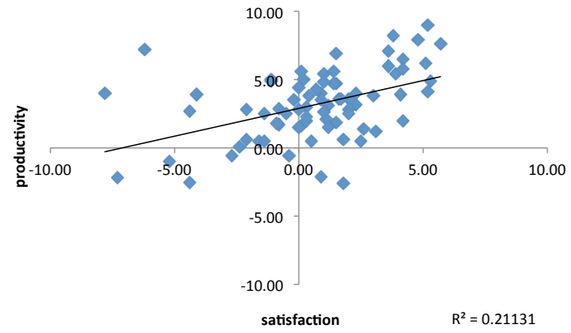
ECOSYSTEM ATTRIBUTES: *RP #2: the components of WEI have a significant positive correlation with each other, moderated by job complexity*

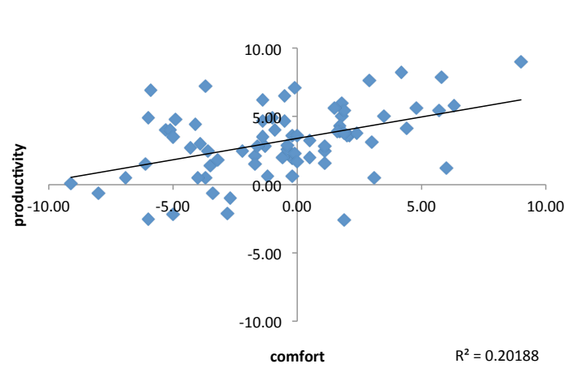


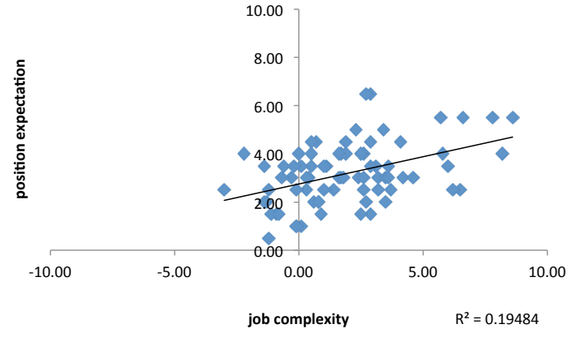
** the ratio of Q1 to Q1-4 can be used to rank the performance of workplaces*

RP #2 TESTS:



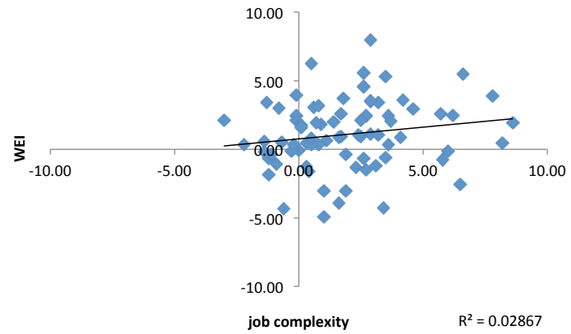


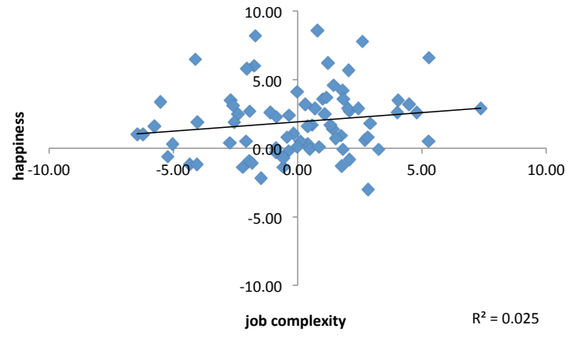


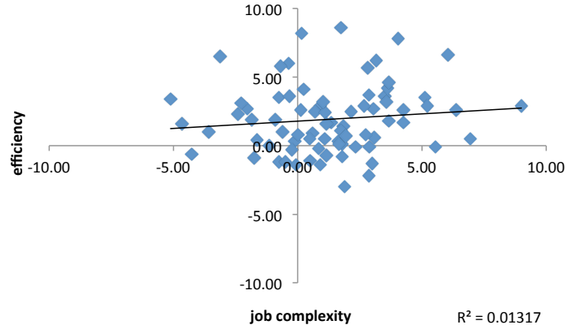


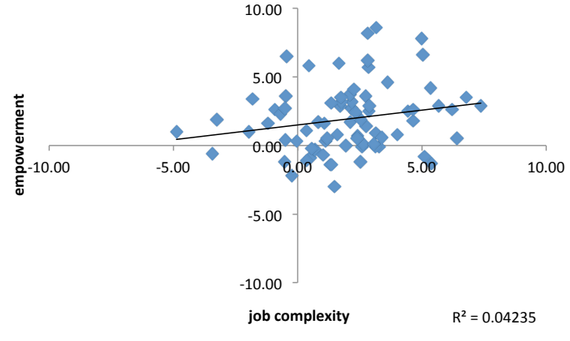
AVERAGE	0.71	-0.66	3.19	0.00	1.29	1.97	1.92	3.18	1.09	1.26	44.74%	1.17
											target 75%	
	building type	*satisfaction*	*comfort*	*productivity*	*happiness*	*efficiency*	*empowerment*	*complexity*	*expectation*	*WEI*	*WPI*	*RP #1 test*	*star rating*
1	GREEN	1.20	3.00	3.10	2.09	3.05	2.16	2.70	2.00	2.43	-0.70		2
2	GREEN	1.50	-0.20	1.90	0.71	0.91	1.70	2.90	6.50	1.12	3.60	2.48	1
3	GREEN	2.30	0.50	3.20	1.41	1.85	2.74	1.40	2.50	2.00	1.10	-0.90	2
4	GREEN	-4.40	-4.30	2.70	-4.35	-0.76	-0.53	-1.20	2.50	-1.84	3.70		0
5	GREEN	-1.60	-3.70	0.50	-2.72	-1.63	-0.49	0.40	3.00	-1.62	2.60		0
6	GREEN	1.60	2.10	3.60	1.84	2.88	2.59	-0.10	1.00	2.43	1.10	-1.33	2
7	GREEN	4.20	-0.50	6.50	1.78	3.00	5.39	-1.30	2.00	3.38	3.30	-0.08	2
8	GREEN	5.20	9.00	9.00	7.37	9.00	7.37	2.90	1.50	7.96	-1.40		4
9	GREEN	0.30	-3.90	3.00	-1.75	-0.37	1.65	6.00	3.50	-0.14	-2.50		0
10	GREEN	-1.10	3.50	5.00	1.32	4.25	2.11	1.70	4.00	2.59	2.30	-0.29	2
11	GREEN	0.00	-1.30	2.80	-0.57	0.90	1.33	-1.40	2.00	0.57	3.40	2.83	1
12	GREEN	-0.50	-3.60	2.50	-2.21	-0.08	1.38	-1.40	3.50	-0.19	4.90		0
13	GREEN	3.80	4.20	8.20	4.00	6.39	6.20	2.60	2.50	5.58	-0.10		3
14	GREEN	0.50	-4.00	0.50	-1.95	-1.75	0.50	-0.90	1.50	-1.08	2.40		0
15	GREEN	-2.70	-8.00	-0.60	-5.52	-5.11	-1.82	3.40	5.00	-4.27	1.60		0
16	GREEN	3.60	1.80	6.00	2.61	4.03	5.00	7.80	5.50	3.91	-2.30		2
17	GREEN	2.60	-3.50	1.40	-0.86	-1.13	1.94	0.00	4.00	-0.08	4.00		0
18	GREEN	0.10	1.10	1.60	0.59	1.35	0.83	1.70	3.00	0.92	1.30	0.38	1
19	GREEN	-6.20	-3.70	7.20	-5.02	1.62	-0.04	0.30	3.00	-1.23	2.70		0
20	GREEN	-1.40	-6.90	0.50	-4.12	-3.12	-0.44	6.50	2.50	-2.55	-4.00		0
21	GREEN	4.20	-0.60	2.00	1.75	0.61	3.15	0.90	1.50	1.83	0.60	-1.23	1
22	GREEN	2.10	2.00	3.60	2.05	2.82	2.85	5.70	5.50	2.58	-0.20		2
23	GREEN	1.50	-5.90	6.90	-2.41	0.70	4.44	2.50	1.50	0.94	-1.00		1

24	GREEN	1.80	-1.20	0.60	0.40	-0.13	1.12	0.30	2.50	0.48	2.20	1.72	1
25	GREEN	-2.10	-0.20	0.60	-1.09	0.12	-0.92	2.60	4.00	-0.64	1.40		0
26	GREEN	2.00	-0.20	3.60	1.09	2.15	2.85	2.50	4.00	2.10	1.50	-0.60	2
27	GREEN	-1.40	1.10	2.50	-0.16	1.74	0.36	1.10	3.50	0.62	2.40	1.78	1
28	GREEN	1.10	-1.70	2.10	-0.42	0.00	1.59	0.80	2.00	0.35	1.20	0.85	1
29	GREEN	1.50	-0.50	4.70	0.49	2.34	3.27	-0.10	2.50	2.08	2.60	0.52	2
30	GREEN	0.20	1.80	5.00	1.00	3.49	2.73	3.60	3.50	2.44	-0.10		2
31	GREEN	3.00	2.40	3.80	2.70	3.08	3.39	0.60	2.00	3.05	1.40	-1.65	2
32	GREEN	2.30	-0.90	4.00	0.79	1.74	3.17	8.60	5.50	1.93	-3.10		1
33	GREEN	5.10	-1.40	6.20	2.01	2.68	5.66	2.90	4.50	3.50	1.60	-1.90	2
34	GREEN	1.70	0.00	3.60	0.86	1.80	2.64	0.10	1.00	1.77	0.90	-0.87	1
35	GREEN	0.90	-5.30	4.00	-2.55	-0.90	2.54	1.90	4.00	-0.37	2.10		0
36	GREEN	1.00	5.70	5.40	3.25	5.55	3.13	-0.10	1.00	3.96	1.10	-2.86	2
37	GREEN	0.90	-1.40	3.50	-0.34	1.10	2.33	2.40	3.00	1.04	0.60	-0.44	1
38	GREEN	5.70	2.90	7.60	4.04	5.12	6.78	3.50	2.00	5.28	-1.50		3
39	GREEN	-1.10	-6.00	4.90	-4.04	-0.49	2.53	-1.20	0.50	-0.64	1.70		0
40	GREEN	-2.40	-9.10	0.10	-5.75	-4.65	-1.19	1.60	3.00	-3.88	1.40		0
41	GREEN	-2.10	-1.60	2.80	-1.84	0.50	0.35	-1.10	1.50	-0.34	2.60		0
42	GREEN	3.10	6.00	1.20	4.48	3.57	2.18	3.20	2.50	3.40	-0.70		2
43	GREEN	0.00	-1.70	1.50	-0.86	-0.24	0.70	-0.30	3.00	-0.16	3.30		0
44	GREEN	1.00	-0.40	2.60	0.30	1.03	1.76	3.20	3.00	1.02	-0.20		1
45	GREEN	2.50	3.10	0.50	2.83	1.90	1.49	-3.00	2.50	2.09	5.50	3.41	2
46	GREEN	3.60	-0.10	7.10	1.82	3.63	5.35	4.20	3.00	3.62	-1.20		2
47	GREEN	-4.40	-6.00	-2.50	-5.22	-4.27	-3.43	-0.60	3.50	-4.31	4.10		0
48	GREEN	-5.20	-2.70	-1.00	-4.02	-1.86	-3.24	1.90	4.50	-3.07	2.60		0
49	GREEN	2.00	1.10	2.80	1.53	1.94	2.42	0.70	4.50	1.96	3.80	1.84	1
50	GREEN	0.70	1.70	4.30	1.23	3.16	2.82	6.20	2.50	2.47	-3.70		2
51	GREEN	0.30	0.50	2.00	0.40	1.16	1.07	1.60	4.00	0.86	2.40	1.54	1
52	GREEN	-4.10	1.70	3.90	-1.47	2.87	-0.23	-2.20	4.00	0.35	6.20	5.85	1
53	GREEN	5.30	-1.00	4.90	2.09	1.79	5.11	-0.80	1.50	2.97	2.30	-0.67	2
54	GREEN	0.00	-4.10	4.40	-2.07	0.48	2.40	0.50	3.50	0.33	3.00	2.67	1
55	GREEN	0.90	-2.80	-2.10	-0.86	-2.41	-0.70	2.30	5.00	-1.32	2.70		0
56	GREEN	0.30	-0.10	2.30	0.12	1.08	1.20	0.50	4.00	0.79	3.50	2.71	1
57	GREEN	-7.80	-5.10	4.00	-6.45	-0.60	-1.96	1.00	2.50	-3.02	1.50		0
58	GREEN	1.40	-1.40	4.70	-0.02	1.65	3.07	0.10	3.50	1.57	3.40	1.83	1
59	GREEN	4.80	5.80	7.90	5.28	6.95	6.42	0.50	4.50	6.23	4.00	-2.23	4
60	GREEN	-0.80	0.00	1.70	-0.37	0.85	0.56	-0.20	3.50	0.36	3.70	3.34	1
61	GREEN	4.10	1.60	3.90	2.82	2.74	4.00	0.80	2.00	3.18	1.20	-1.98	2
62	GREEN	0.40	1.90	3.80	1.14	2.86	2.10	3.70	2.50	2.03	-1.20		2
63	GREEN	3.90	1.90	5.40	2.91	3.67	4.65	1.80	3.00	3.75	1.20	-2.55	2
64	GREEN	-0.80	-0.40	2.90	-0.59	1.15	1.03	-0.70	3.00	0.52	3.70	3.18	1
65	GREEN	-0.20	-5.00	3.50	-2.70	-0.75	1.73	3.50	3.00	-0.58	-0.50		0
66	GREEN	4.20	6.30	5.80	5.28	6.04	5.04	6.60	5.50	5.47	-1.10		3
67	GREEN	1.00	-4.90	4.80	-1.69	0.17	2.82	8.20	4.00	0.47	-4.20		1
68	GREEN	2.00	-2.20	2.50	-0.01	0.25	2.25	4.10	4.50	0.85	0.40	-0.45	1
69	GREEN	1.80	1.90	-2.60	1.85	-0.33	-0.47	3.60	3.00	0.35	-0.60		1
70	GREEN	-0.40	-3.40	-0.60	-1.93	-2.03	-0.50	2.70	6.50	-1.50	3.80		0
71	GREEN	-0.90	-3.20	1.80	-2.05	-0.70	0.45	5.80	4.00	-0.77	-1.80		0
72	GREEN	1.40	1.50	5.60	1.45	3.67	3.62	4.60	3.00	2.94	-1.60		2
73	GREEN	1.20	-6.10	1.50	-2.61	-2.26	1.36	3.10	3.50	-1.18	0.40		0
74	GREEN	5.20	4.40	4.10	4.80	4.25	4.66	2.60	3.00	4.57	0.40	-4.17	3
75	GREEN	-7.30	-5.00	-2.20	-6.22	-3.58	-4.87	1.00	3.50	-4.91	2.50		0
76	GREEN	0.10	4.80	5.60	2.45	5.21	2.88	2.90	3.50	3.52	0.60	-2.92	2







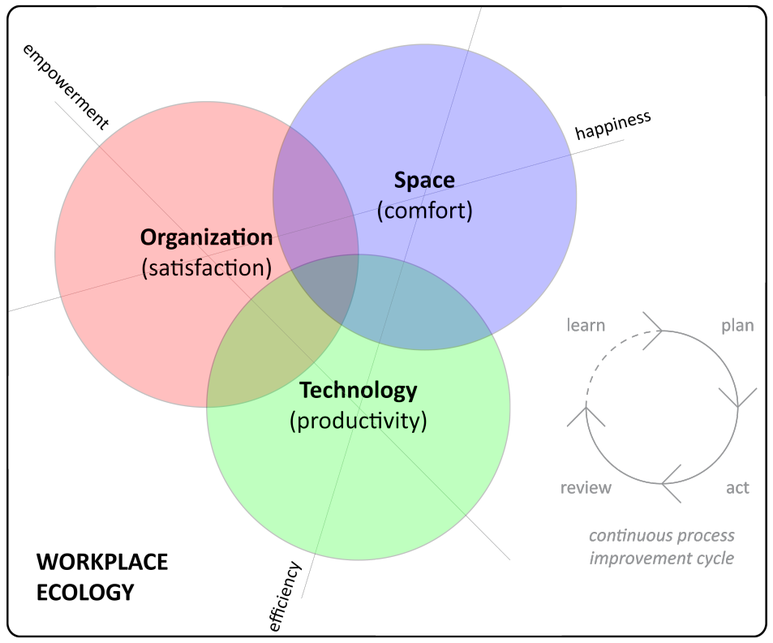


SUMMARY ANALYSIS

RESPONSE RATE: 50.00% (minimum 30% required)

SURVEY POPULATION: 64

CONCEPTUAL FRAMEWORK:



AVERAGE OPINION X WEIGHT
N

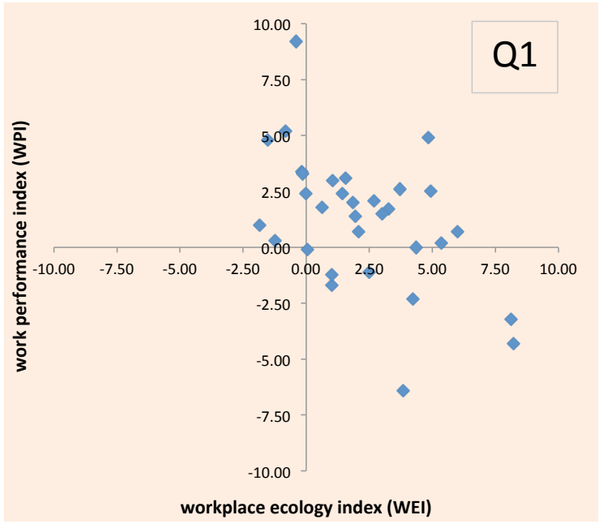
OPINION=1
N

WEIGHTING=5
N

RESEARCH PROPOSITIONS (RP):

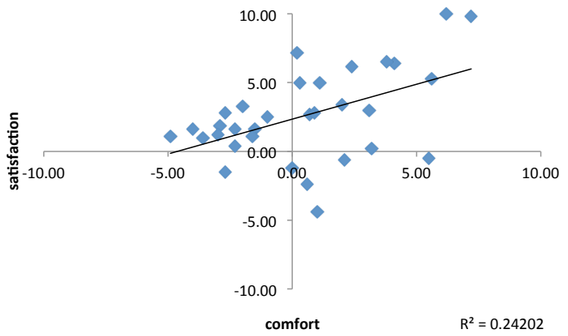
HEALTHY ECOSYSTEMS: *RP #1: at least three-quarters of the values for WEI and WPI must fall within quadrant Q1 for a balanced work 'ecosystem'**

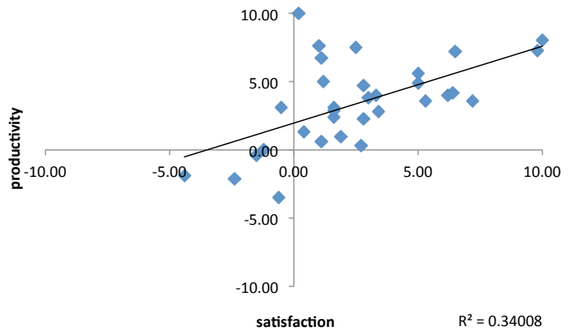
ECOSYSTEM ATTRIBUTES: *RP #2: the components of WEI have a significant positive correlation with each other, moderated by job complexity*

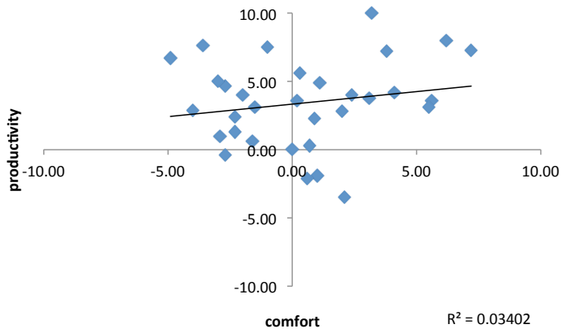


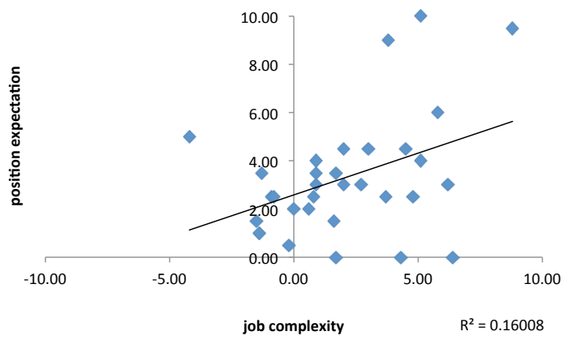
** the ratio of Q1 to Q1-4 can be used to rank the performance of workplaces*

RP #2 TESTS:







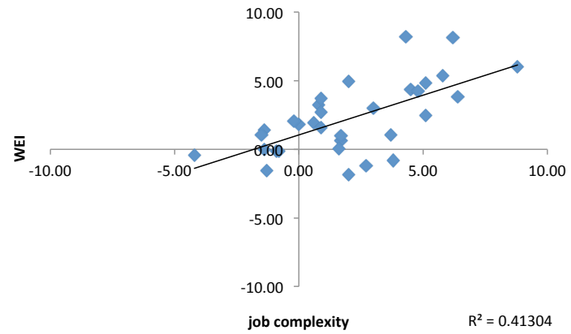


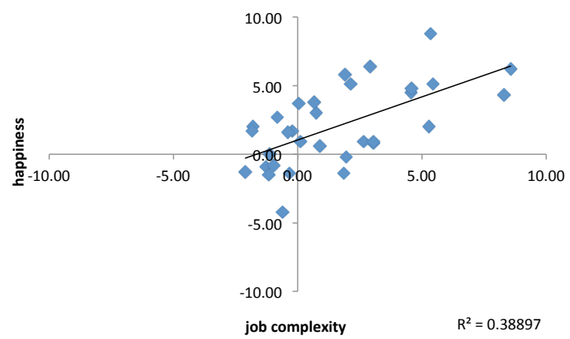
AVERAGE	2.59	0.48	3.43	1.61	1.99	3.06	2.05	3.30	2.24	1.25	46.88%	1.59
											target 75%	

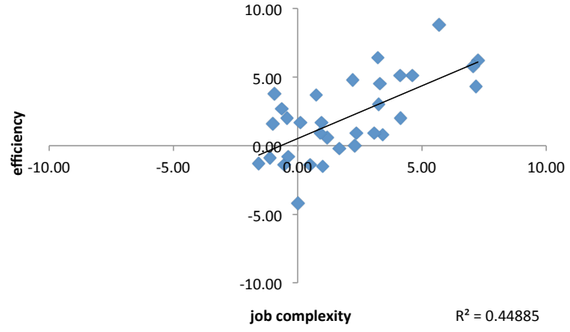
	building type	*satisfaction*	*comfort*	*productivity*	*happiness*	*efficiency*	*empowerment*	*complexity*	*expectation*	*WEI*	*WPI*	*RP #1 test*	*star rating*
1	MODERN	6.20	2.40	4.00	4.56	3.30	5.11	4.50	4.50	4.36	0.00		3
2	MODERN	3.30	-2.00	4.00	0.89	1.20	3.64	0.60	2.00	1.95	1.40	-0.55	1
3	MODERN	1.60	-2.30	2.40	-0.22	0.11	1.98	1.70	3.50	0.64	1.80	1.16	1
4	MODERN	2.70	0.70	0.30	1.86	0.50	1.71	-1.40	1.00	1.41	2.40	0.99	1
5	MODERN	-4.40	1.00	-1.90	-1.81	-0.43	-3.22	2.00	3.00	-1.84	1.00		0
6	MODERN	6.40	4.10	4.20	5.29	4.15	5.33	2.00	4.50	4.93	2.50	-2.43	3
7	MODERN	1.10	-4.90	6.70	-1.83	0.96	3.87	1.70	0.00	1.01	-1.70		1
8	MODERN	3.00	3.10	3.80	3.05	3.42	3.33	0.80	2.50	3.26	1.70	-1.56	2
9	MODERN	5.30	5.60	3.60	5.45	4.60	4.46	5.10	10.00	4.84	4.90	0.06	3
10	MODERN	9.80	7.20	7.30	8.57	7.25	8.55	6.20	3.00	8.13	-3.20		5
11	MODERN	1.60	-1.50	3.10	0.05	0.74	2.33	3.70	2.50	1.03	-1.20		1
12	MODERN	7.20	0.20	3.60	4.58	2.21	5.53	4.80	2.50	4.23	-2.30		3
13	MODERN	5.00	0.30	5.60	2.91	3.22	5.30	6.40	0.00	3.86	-6.40		2
14	MODERN	1.00	-3.60	7.60	-1.13	2.31	4.23	0.00	2.00	1.84	2.00	0.16	1
15	MODERN	2.50	-1.00	7.50	0.75	3.25	5.00	3.00	4.50	3.00	1.50	-1.50	2
16	MODERN	-0.60	2.10	-3.50	0.67	-0.94	-2.08	3.80	9.00	-0.82	5.20		0
17	MODERN	2.80	-2.70	4.70	0.11	0.91	3.71	0.90	4.00	1.57	3.10	1.53	1
18	MODERN	3.40	2.00	2.80	2.66	2.37	3.11	0.90	3.00	2.70	2.10	-0.60	2
19	MODERN	-1.50	-2.70	-0.40	-2.10	-1.56	-0.96	-1.30	3.50	-1.54	4.80		0
20	MODERN	1.60	-4.00	2.90	-1.29	-1.11	2.16	-0.90	2.50	-0.15	3.40		0
21	MODERN	2.80	0.90	2.30	1.96	1.68	2.55	-0.20	0.50	2.08	0.70	-1.38	2
22	MODERN	10.00	6.20	8.00	8.31	7.18	9.02	4.30	0.00	8.20	-4.30		5
23	MODERN	0.20	3.20	10.00	1.90	7.06	6.40	5.80	6.00	5.36	0.20	-5.16	3

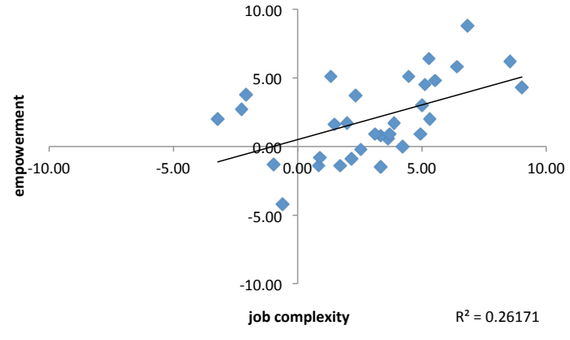
OLDER LOW QUALITY NON-GREEN BUILDING (IN NEED OF REFURBISHMENT)

24	MODERN	1.90	-2.90	1.00	-0.39	-1.00	1.48	1.60	1.50	0.04	-0.10	1
25	MODERN	6.50	3.80	7.20	5.36	5.69	6.84	8.80	9.50	5.99	0.70	-5.29	3
26	MODERN	-2.40	0.60	-2.10	-0.83	-0.65	-2.25	2.70	3.00	-1.22	0.30	0
27	MODERN	1.20	-3.00	5.00	-1.16	1.00	3.33	-1.50	1.50	1.06	3.00	1.94	1
28	MODERN	-0.50	5.50	3.10	2.13	4.12	1.34	5.10	4.00	2.49	-1.10	2
29	MODERN	-1.20	0.00	0.00	-0.60	0.00	-0.60	-4.20	5.00	-0.40	9.20	0
30	MODERN	1.10	-1.60	0.60	-0.33	-0.53	0.84	-1.40	1.00	-0.02	2.40	0
31	MODERN	0.40	-2.30	1.30	-0.97	-0.38	0.89	-0.80	2.50	-0.14	3.30	0
32	MODERN	5.00	1.10	4.90	3.05	3.08	4.95	0.90	3.50	3.70	2.60	-1.10	2









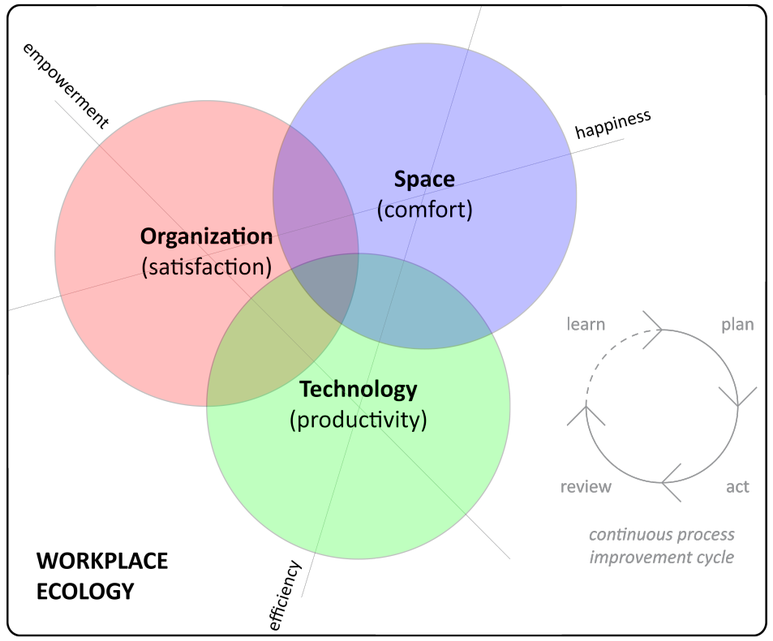
OLDER LOW QUALITY NON-GREEN BUILDING (IN NEED OF REFURBISHMENT)

SUMMARY ANALYSIS

RESPONSE RATE: 65.91% (minimum 30% required)

SURVEY POPULATION: 44

CONCEPTUAL FRAMEWORK:



AVERAGE OPINION X WEIGHT
N

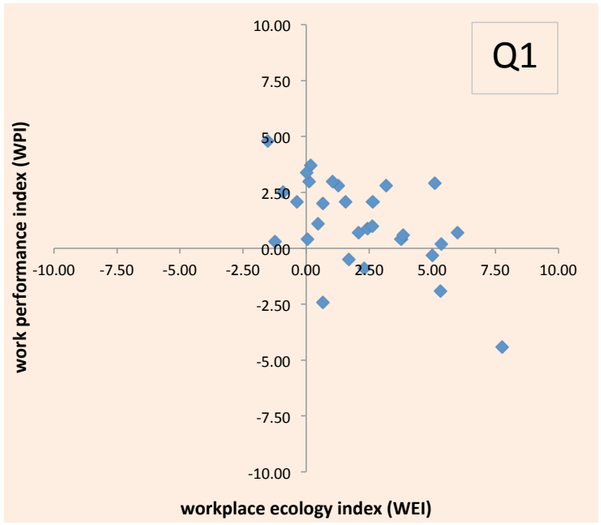
OPINION=1
N

WEIGHTING=5
N

RESEARCH PROPOSITIONS (RP):

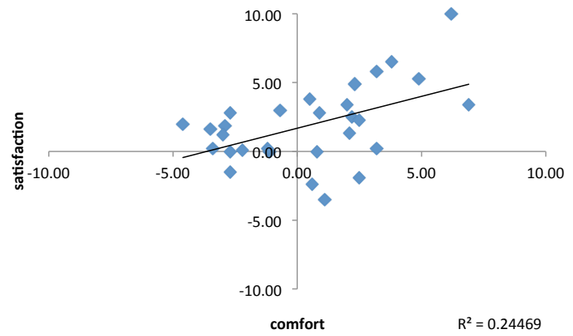
HEALTHY ECOSYSTEMS: *RP #1: at least three-quarters of the values for WEI and WPI must fall within quadrant Q1 for a balanced work 'ecosystem'**

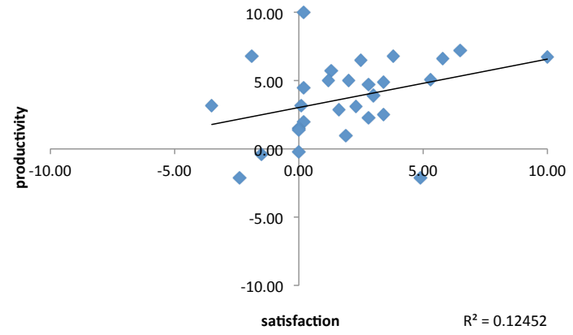
ECOSYSTEM ATTRIBUTES: *RP #2: the components of WEI have a significant positive correlation with each other, moderated by job complexity*

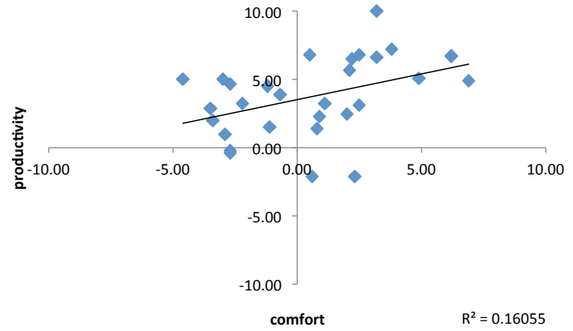


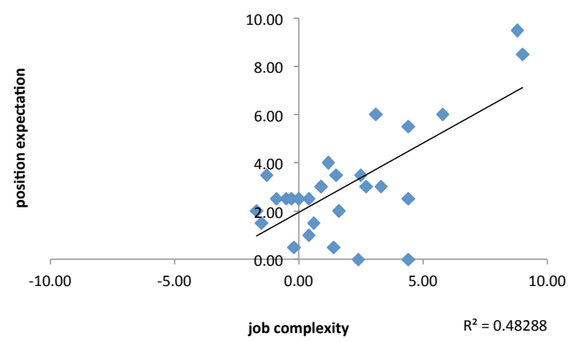
** the ratio of Q1 to Q1-4 can be used to rank the performance of workplaces*

RP #2 TESTS:





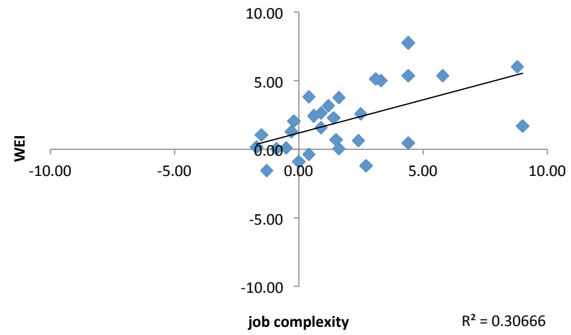


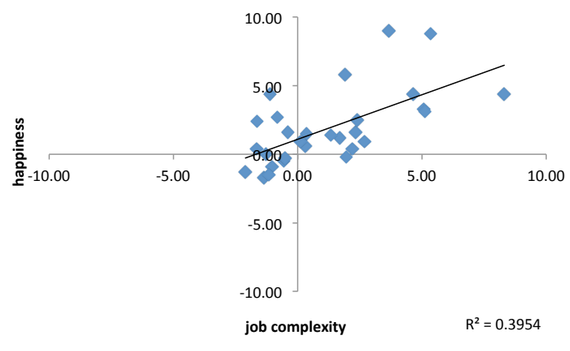


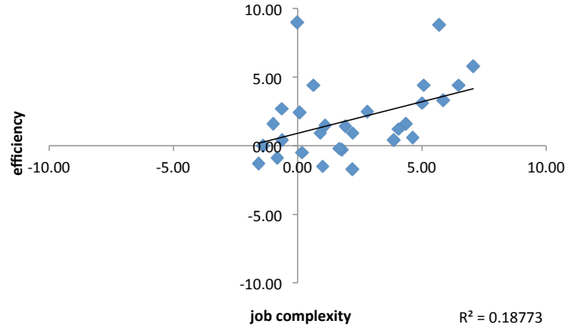
AVERAGE		1.93	0.52	3.71	1.24	2.16	2.89	1.89	3.03	2.11	1.14	65.52%	1.59
												target 75%	
	building type	*satisfaction*	*comfort*	*productivity*	*happiness*	*efficiency*	*empowerment*	*complexity*	*expectation*	*WEI*	*WPI*	*RP #1 test*	*star rating*
1	MODERN	4.90	2.30	-2.10	3.67	-0.02	1.40	9.00	8.50	1.68	-0.50		1
2	MODERN	0.10	-2.20	3.20	-1.10	0.64	1.80	4.40	5.50	0.48	1.10	0.62	1
3	MODERN	0.20	-3.40	2.00	-1.65	-0.63	1.15	0.40	2.50	-0.37	2.10		0
4	MODERN	2.50	2.20	6.50	2.34	4.35	4.57	1.60	2.00	3.76	0.40	-3.36	2
5	MODERN	1.30	2.10	5.70	1.69	4.05	3.63	1.20	4.00	3.15	2.80	-0.35	2
6	MODERN	0.00	-1.10	1.50	-0.55	0.18	0.74	-0.50	2.50	0.12	3.00	2.88	1
7	MODERN	3.00	-0.70	3.90	1.34	1.93	3.47	1.40	0.50	2.30	-0.90		2
8	MODERN	3.80	0.50	6.80	2.20	3.86	5.36	0.40	1.00	3.84	0.60	-3.24	2
9	MODERN	5.80	3.20	6.60	4.63	5.07	6.20	4.40	2.50	5.33	-1.90		3
10	MODERN	0.00	0.80	1.40	0.36	1.09	0.61	1.50	3.50	0.67	2.00	1.33	1
11	MODERN	0.20	-1.20	4.50	-0.50	1.77	2.44	-0.30	2.50	1.26	2.80	1.54	1
12	MODERN	2.00	-4.60	5.00	-1.63	0.09	3.62	2.40	0.00	0.65	-2.40		1
13	MODERN	3.40	6.90	4.90	5.07	5.86	4.14	3.30	3.00	5.01	-0.30		3
14	MODERN	-1.90	2.50	6.80	0.30	4.62	2.40	0.60	1.50	2.43	0.90	-1.53	2
15	MODERN	-3.50	1.10	3.20	-1.36	2.19	-0.24	-1.70	2.00	0.18	3.70	3.52	1
16	MODERN	5.30	4.90	5.10	5.12	5.00	5.20	3.10	6.00	5.11	2.90	-2.21	3
17	MODERN	0.00	-2.70	-0.20	-1.29	-1.39	-0.10	0.00	2.50	-0.91	2.50		0
18	MODERN	2.30	2.50	3.10	2.40	2.79	2.69	2.50	3.50	2.62	1.00	-1.62	2
19	MODERN	2.80	-2.70	4.70	0.11	0.91	3.71	0.90	3.00	1.57	2.10	0.53	1
20	MODERN	3.40	2.00	2.50	2.68	2.21	3.00	0.90	3.00	2.63	2.10	-0.53	2
21	MODERN	-1.50	-2.70	-0.40	-2.10	-1.56	-0.96	-1.30	3.50	-1.54	4.80		0
22	MODERN	1.60	-3.50	2.90	-1.03	-0.82	2.16	-0.90	2.50	0.03	3.40	3.37	1
23	MODERN	2.80	0.90	2.30	1.96	1.68	2.55	-0.20	0.50	2.08	0.70	-1.38	2

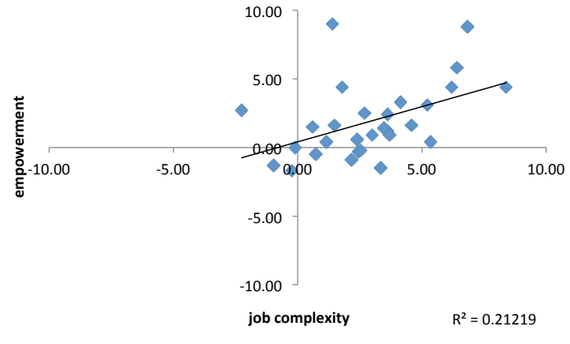
RECENT HIGH QUALITY NON-GREEN BUILDING (CBD LOCATION)

24	MODERN	10.00	6.20	6.70	8.31	6.47	8.38	4.40	0.00	7.75	-4.40	4
25	MODERN	0.20	3.20	10.00	1.90	7.06	6.40	5.80	6.00	5.36	0.20	-5.16	3
26	MODERN	1.90	-2.90	1.00	-0.39	-0.97	1.48	1.60	2.00	0.05	0.40	0.35	1
27	MODERN	6.50	3.80	7.20	5.36	5.69	6.84	8.80	9.50	5.99	0.70	-5.29	3
28	MODERN	-2.40	0.60	-2.10	-0.83	-0.65	-2.25	2.70	3.00	-1.22	0.30		0
29	MODERN	1.20	-3.00	5.00	-1.16	1.00	3.33	-1.50	1.50	1.06	3.00	1.94	1







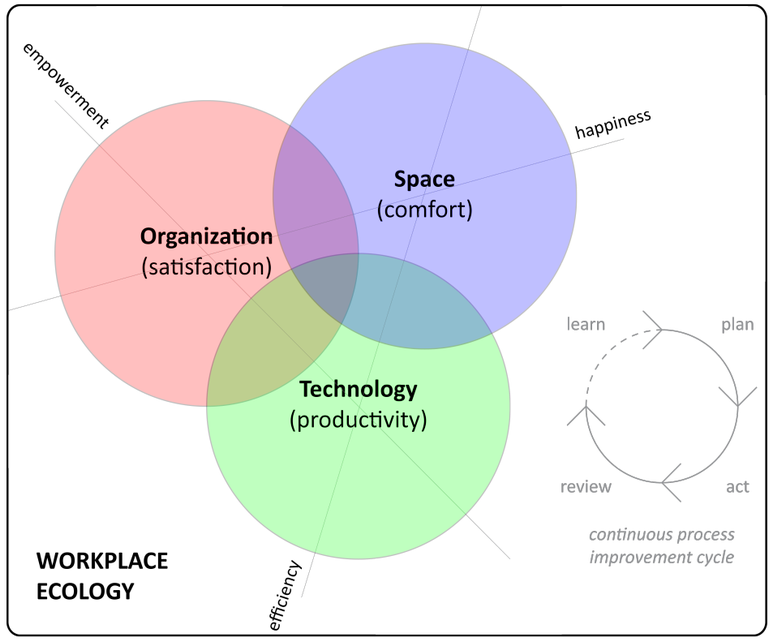


SUMMARY ANALYSIS

RESPONSE RATE: 35.60% (minimum 30% required)

SURVEY POPULATION: 500

CONCEPTUAL FRAMEWORK:



AVERAGE OPINION X WEIGHT
N

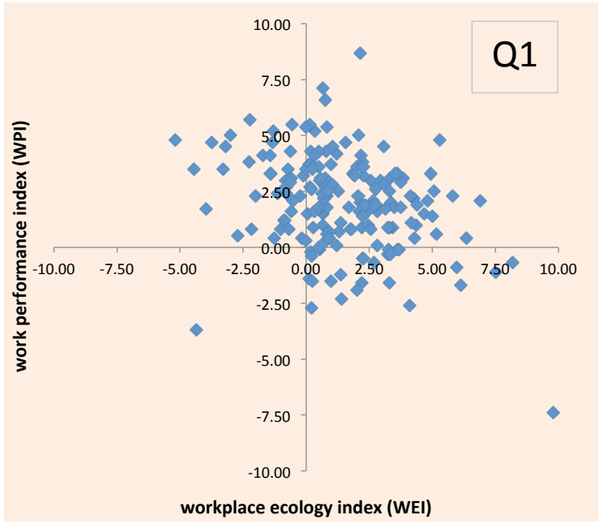
OPINION=1
N

WEIGHTING=5
N

RESEARCH PROPOSITIONS (RP):

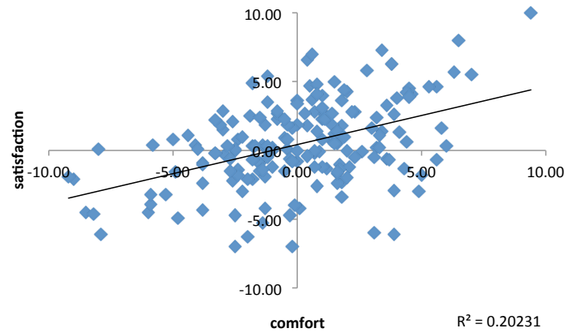
HEALTHY ECOSYSTEMS: *RP #1: at least three-quarters of the values for WEI and WPI must fall within quadrant Q1 for a balanced work 'ecosystem'**

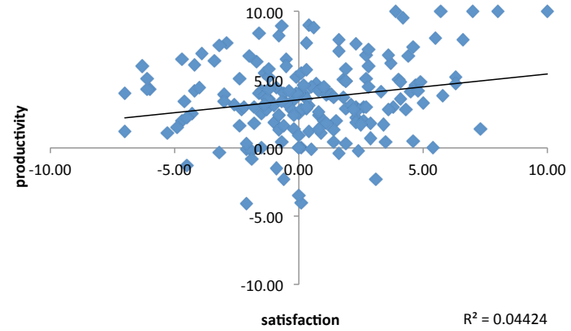
ECOSYSTEM ATTRIBUTES: *RP #2: the components of WEI have a significant positive correlation with each other, moderated by job complexity*

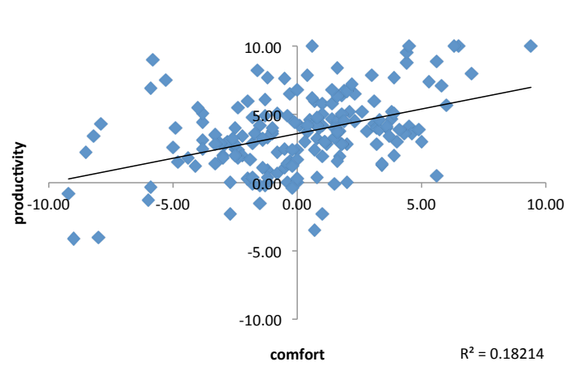


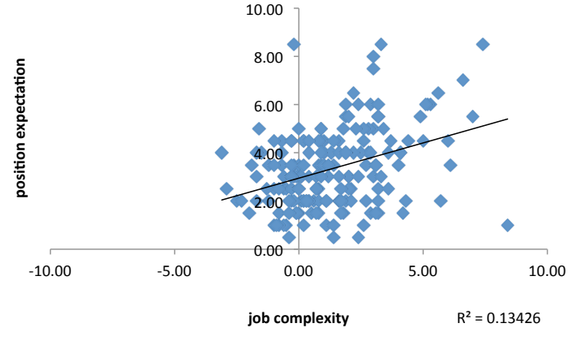
** the ratio of Q1 to Q1-4 can be used to rank the performance of workplaces*

RP #2 TESTS:





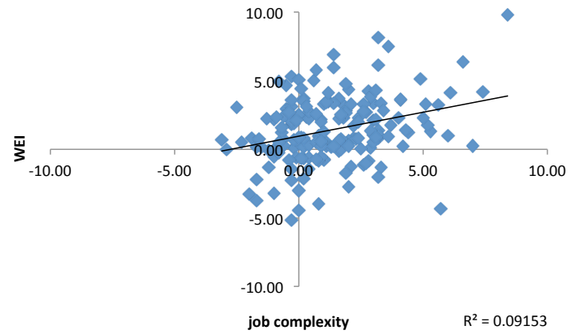


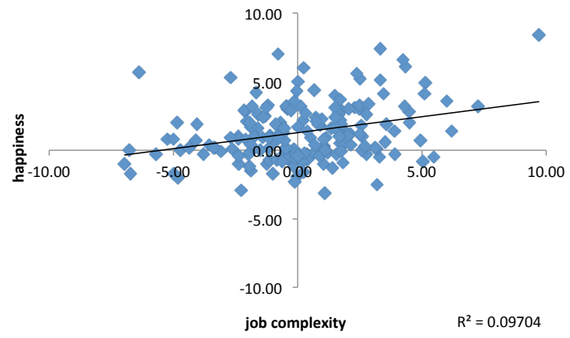


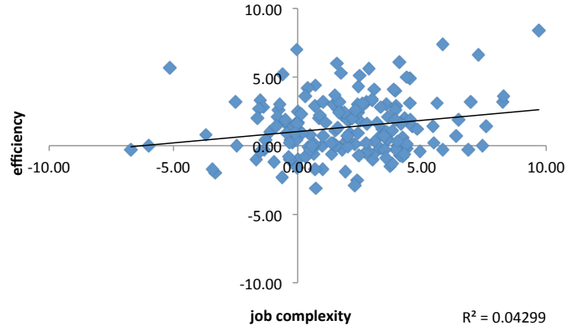
AVERAGE	0.44	0.04	3.61	0.23	1.89	2.10	1.34	3.34	1.43	2.00	62.36%	1.35
											target 75%	
	building type	*satisfaction*	*comfort*	*productivity*	*happiness*	*efficiency*	*empowerment*	*complexity*	*expectation*	*WEI*	*WPI*	*RP #1 test*	*star rating*
1	MODERN	-0.90	-1.50	-1.50	-1.21	-1.50	-1.21	3.30	8.50	-1.31	5.20		0
2	MODERN	4.70	0.50	4.60	2.56	2.51	4.65	1.80	1.50	3.23	-0.30		2
3	MODERN	-4.50	-6.00	-1.30	-5.25	-3.70	-2.93	0.80	2.50	-3.97	1.70		0
4	MODERN	-1.20	-1.00	3.60	-1.11	1.51	1.14	1.10	1.00	0.52	-0.10		1
5	MODERN	0.10	-0.40	0.00	-0.16	-0.19	0.05	-1.20	2.00	-0.10	3.20		0
6	MODERN	-2.10	-9.00	-4.10	-5.69	-6.71	-3.08	-0.30	4.50	-5.19	4.80		0
7	MODERN	2.30	-0.80	2.20	0.67	0.72	2.25	4.40	4.50	1.21	0.10	-1.11	1
8	MODERN	0.70	1.40	4.70	1.05	3.10	2.77	0.30	2.00	2.32	1.70	-0.62	2
9	MODERN	4.90	-1.80	4.80	1.64	1.58	4.85	2.70	2.00	2.71	-0.70		2
10	MODERN	0.40	-5.80	9.00	-2.70	1.75	4.79	5.30	6.00	1.31	0.70	-0.61	1
11	MODERN	-1.00	1.70	1.90	0.23	1.80	0.39	2.20	6.50	0.79	4.30	3.51	1
12	MODERN	1.50	-3.00	2.00	-0.75	-0.50	1.75	1.70	1.50	0.17	-0.20		1
13	MODERN	-0.80	-0.20	1.30	-0.51	0.58	0.26	-0.20	3.50	0.11	3.70	3.59	1
14	MODERN	-0.20	-3.30	3.50	-1.67	0.40	1.72	4.20	1.50	0.20	-2.70		1
15	MODERN	0.40	-4.10	1.20	-2.09	-1.38	0.85	2.80	4.00	-0.88	1.20		0
16	MODERN	-0.30	-2.90	2.80	-1.60	-0.09	1.23	1.60	2.00	-0.16	0.40		0
17	MODERN	0.00	-2.50	2.50	-1.25	0.00	1.25	-1.00	2.50	0.00	3.50		0
18	MODERN	0.80	-2.40	2.40	-0.80	0.00	1.60	1.10	2.00	0.27	0.90	0.63	1
19	MODERN	-0.10	2.60	5.20	1.11	4.02	2.52	0.00	3.00	2.54	3.00	0.46	2
20	MODERN	4.50	4.50	4.10	4.50	4.30	4.29	2.00	3.00	4.36	1.00	-3.36	3
21	MODERN	-0.80	0.00	2.40	-0.38	1.37	1.09	-0.60	2.50	0.75	3.10	2.35	1
22	MODERN	2.80	0.70	6.00	1.67	3.58	4.66	3.00	5.00	3.36	2.00	-1.36	2
23	MODERN	5.40	-1.20	0.00	2.52	-0.61	3.09	5.20	6.00	1.77	0.80	-0.97	1

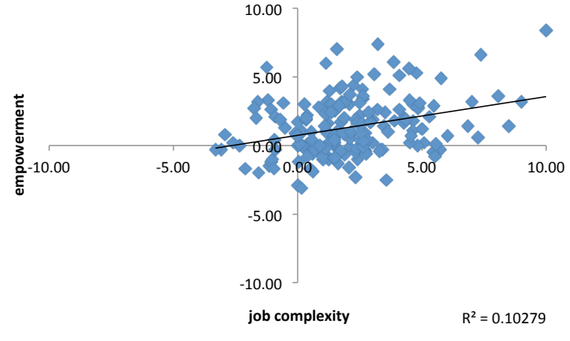
OLDER MEDIUM QUALITY NON-GREEN BUILDING (REGIONAL LOCATION)

24	MODERN	4.10	4.60	3.60	4.33	4.09	3.86	6.10	3.50	4.10	-2.60		3
25	MODERN	-1.50	-0.50	2.50	-1.00	1.00	0.50	-1.70	2.00	0.17	3.70	3.53	1
26	MODERN	0.00	2.00	0.00	1.02	0.99	0.00	0.00	1.50	0.67	1.50	0.83	1
27	MODERN	-1.40	-2.40	5.50	-1.88	1.71	2.08	-0.10	1.50	0.66	1.60	0.94	1
28	MODERN	4.30	2.00	2.80	3.19	2.40	3.58	-2.50	2.00	3.06	4.50	1.44	2
29	MODERN	-0.90	-3.80	4.40	-2.16	0.71	1.66	2.90	1.50	0.11	-1.40		1
30	MODERN	5.80	2.80	3.80	4.48	3.33	4.86	2.80	5.00	4.25	2.20	-2.05	3
31	MODERN	-3.40	1.80	6.40	-1.13	4.14	0.96	-0.70	3.50	1.21	4.20	2.99	1
32	MODERN	3.70	0.60	6.20	2.11	3.40	4.98	1.20	3.00	3.50	1.80	-1.70	2
33	MODERN	0.40	-1.40	3.10	-0.45	1.02	1.78	3.20	5.50	0.81	2.30	1.49	1
34	MODERN	0.10	-8.00	-4.00	-4.72	-6.00	-2.34	0.00	3.50	-4.45	3.50		0
35	MODERN	-0.60	-2.70	-2.30	-1.83	-2.50	-1.60	3.20	5.50	-2.01	2.30		0
36	MODERN	-2.30	1.80	2.80	-0.15	2.31	0.40	0.10	3.00	0.88	2.90	2.02	1
37	MODERN	1.90	-1.30	4.90	0.38	1.80	3.33	-0.30	3.00	1.84	3.30	1.46	1
38	MODERN	0.50	1.60	4.50	1.04	3.02	2.41	-1.00	1.00	2.14	2.00	-0.14	2
39	MODERN	0.30	-1.80	2.90	-0.83	0.37	1.60	-0.70	4.50	0.34	5.20	4.86	1
40	MODERN	2.60	3.90	2.00	3.29	3.12	2.34	-0.50	2.50	2.94	3.00	0.06	2
41	MODERN	-2.90	3.90	7.70	0.61	5.84	2.69	-0.30	2.50	3.10	2.80	-0.30	2
42	MODERN	0.20	-1.00	3.80	-0.41	1.45	2.08	3.00	7.50	1.06	4.50	3.44	1
43	MODERN	-1.20	2.10	5.20	0.51	3.69	2.20	0.90	5.00	2.16	4.10	1.94	2
44	MODERN	-0.80	-1.60	8.20	-1.13	5.49	5.08	0.20	2.00	3.74	1.80	-1.94	2
45	MODERN	-6.00	3.10	4.30	-1.88	3.72	-1.15	-1.50	4.00	0.14	5.50	5.36	1
46	MODERN	-1.30	1.20	2.80	-0.01	1.92	0.62	-1.90	3.50	0.83	5.40	4.57	1
47	MODERN	-1.50	-1.50	4.20	-1.50	1.54	1.48	0.00	3.00	0.55	3.00	2.45	1
48	MODERN	-2.20	-2.60	3.00	-2.39	0.11	0.20	1.00	4.50	-0.72	3.50		0
49	MODERN	0.60	4.40	8.80	2.76	6.86	5.74	-0.30	4.50	5.30	4.80	-0.50	3
50	MODERN	2.90	-3.00	1.80	-0.12	-0.63	2.34	-2.30	2.00	0.52	4.30	3.78	1
51	MODERN	1.80	0.40	3.70	1.14	2.10	2.73	0.90	4.50	1.99	3.60	1.61	1
52	MODERN	-2.10	-1.80	-0.10	-1.94	-0.95	-1.06	-1.20	3.50	-1.31	4.70		0
53	MODERN	0.80	1.00	4.20	0.90	2.83	2.72	-0.40	0.50	2.21	0.90	-1.31	2
54	MODERN	-7.00	-2.50	4.00	-4.97	0.71	-2.11	-1.70	4.00	-2.23	5.70		0
55	MODERN	-1.60	-4.90	4.00	-3.33	-0.22	1.48	0.20	4.50	-0.63	4.30		0
56	MODERN	2.70	-0.80	5.10	0.91	2.05	3.89	1.80	5.00	2.26	3.20	0.94	2
57	MODERN	-0.60	-0.30	1.60	-0.43	0.65	0.61	-0.60	3.00	0.29	3.60	3.31	1
58	MODERN	-3.20	-5.30	7.50	-4.37	1.44	3.02	0.20	4.50	0.16	4.30	4.14	1
59	MODERN	0.00	0.00	0.00	0.00	0.00	0.00	1.70	2.00	0.00	0.30		0
60	MODERN	-1.20	1.00	5.80	-0.05	3.34	2.39	-0.20	3.00	1.90	3.20	1.30	1
61	MODERN	-0.20	-3.30	1.40	-1.75	-1.11	0.55	1.00	4.00	-0.79	3.00		0
62	MODERN	-3.90	-5.90	6.90	-4.99	0.50	1.99	0.80	3.50	-0.79	2.70		0
63	MODERN	-1.00	-3.80	3.10	-2.37	-0.31	1.03	-1.00	4.50	-0.54	5.50		0
64	MODERN	-0.70	5.60	8.90	2.58	7.44	4.83	0.00	2.50	5.08	2.50	-2.58	3
65	MODERN	-0.50	2.30	6.50	0.82	4.53	3.04	1.90	2.00	2.81	0.10	-2.71	2
66	MODERN	0.20	3.20	4.00	1.70	3.60	2.10	0.50	1.50	2.47	1.00	-1.47	2
67	MODERN	-1.40	1.70	3.80	0.13	2.76	1.20	3.20	2.00	1.36	-1.20		1
68	MODERN	-2.40	1.60	1.60	-0.55	1.60	-0.50	1.30	4.00	0.15	2.70	2.55	1
69	MODERN	-1.90	-1.30	-0.20	-1.59	-0.78	-1.06	2.60	5.00	-1.15	2.40		0
70	MODERN	1.40	3.40	1.30	2.47	2.41	1.35	3.00	8.00	2.09	5.00	2.91	2
71	MODERN	-2.10	-2.00	0.30	-2.05	-0.83	-0.90	2.10	2.50	-1.26	0.40		0
72	MODERN	0.00	-1.20	0.90	-0.64	-0.36	0.39	-0.80	1.50	-0.23	2.30		0
73	MODERN	-4.70	-0.30	6.50	-2.39	3.36	1.59	0.80	4.50	0.98	3.70	2.72	1
74	MODERN	10.00	9.40	10.00	9.70	9.70	10.00	8.40	1.00	9.80	-7.40		5
75	MODERN	-6.10	-7.90	4.30	-6.96	-1.66	-1.01	-1.00	3.50	-3.21	4.50		0
76	MODERN	3.60	0.00	6.80	1.77	3.95	5.48	2.90	6.00	3.85	3.10	-0.75	2
77	MODERN	1.80	1.80	5.00	1.80	4.17	4.27	1.60	4.50	3.74	2.90	-0.84	2
78	MODERN	1.60	3.00	7.90	2.29	5.60	4.90	3.10	3.50	4.30	0.40	-3.90	3
79	MODERN	0.10	-2.50	2.80	-1.31	0.02	1.50	2.50	4.00	0.05	1.50	1.45	1
80	MODERN	1.90	1.40	5.80	1.66	3.92	4.08	2.60	1.00	3.29	-1.60		2
81	MODERN	-0.50	3.10	6.00	1.62	4.61	3.46	1.40	4.50	3.33	3.10	-0.23	2
82	MODERN	7.30	3.40	1.40	5.48	2.71	5.45	-0.50	1.00	4.68	1.50	-3.18	3
83	MODERN	0.30	-1.70	3.60	-0.69	0.85	1.87	2.00	3.00	0.66	1.00	0.34	1









84	MODERN	1.00	-2.20	2.00	-0.78	-0.05	1.57	7.00	5.50	0.25	-1.50	1
85	MODERN	-4.20	-1.30	6.10	-2.70	2.44	1.18	0.90	5.00	0.34	4.10	3.76	1
86	MODERN	2.90	-0.80	0.70	1.03	-0.12	1.89	0.80	1.50	0.93	0.70	-0.23	1
87	MODERN	-0.60	3.60	4.00	1.40	3.80	1.62	-1.30	2.50	2.25	3.80	1.55	2
88	MODERN	6.60	0.40	7.90	3.53	4.23	7.26	0.60	2.00	5.02	1.40	-3.62	3
89	MODERN	-1.30	4.30	3.60	1.50	3.93	1.29	4.00	3.50	2.25	-0.50		2
90	MODERN	4.20	4.40	9.50	4.31	6.98	7.02	3.20	1.50	6.12	-1.70		4
91	MODERN	-2.60	0.80	3.20	-0.88	2.00	0.34	1.90	5.50	0.49	3.60	3.11	1
92	MODERN	-1.90	-9.20	-0.80	-6.38	-5.14	-1.24	5.70	2.00	-4.34	-3.70		0
93	MODERN	1.90	0.00	0.30	0.98	0.15	1.12	2.30	5.00	0.75	2.70	1.95	1
94	MODERN	6.30	3.80	5.20	5.13	4.52	5.77	4.90	5.50	5.15	0.60	-4.55	3
95	MODERN	0.00	-1.00	4.00	-0.44	1.67	1.90	3.20	6.00	1.05	2.80	1.75	1
96	MODERN	4.60	5.60	0.50	5.09	3.08	2.60	4.10	4.00	3.60	-0.10		2
97	MODERN	-3.00	4.90	3.90	1.21	4.40	0.68	-0.20	8.50	2.14	8.70	6.56	2
98	MODERN	-1.80	5.00	3.00	1.56	3.95	0.69	-0.30	2.00	2.07	2.30	0.23	2
99	MODERN	2.60	1.10	3.00	1.85	2.00	2.79	0.40	4.00	2.21	3.60	1.39	2
100	MODERN	3.40	0.00	1.70	1.70	0.90	2.50	2.20	4.00	1.70	1.80	0.10	1
101	MODERN	1.60	-0.20	-0.40	0.69	-0.30	0.59	0.40	2.00	0.32	1.60	1.28	1
102	MODERN	-0.20	0.70	2.40	0.25	1.57	1.13	6.00	4.50	0.99	-1.50		1
103	MODERN	6.30	3.80	4.70	5.04	4.23	5.53	-0.80	2.50	4.93	3.30	-1.63	3
104	MODERN	1.90	-0.40	4.90	0.73	2.44	3.53	2.40	6.00	2.27	3.60	1.33	2
105	MODERN	-0.50	-1.20	3.30	-0.87	1.02	1.47	0.70	2.50	0.54	1.80	1.26	1
106	MODERN	4.40	1.90	6.70	3.18	4.39	5.56	0.10	2.00	4.39	1.90	-2.49	3
107	MODERN	-1.70	1.60	6.30	-0.10	4.29	2.76	-0.60	1.00	2.42	1.60	-0.82	2
108	MODERN	2.80	2.30	4.50	2.59	3.58	3.64	1.00	3.50	3.29	2.50	-0.79	2
109	MODERN	-1.80	-2.40	1.80	-2.10	-0.36	-0.07	0.80	2.00	-0.86	1.20		0
110	MODERN	7.00	0.60	10.00	3.90	5.45	8.50	1.40	0.50	5.97	-0.90		3
111	MODERN	-0.10	0.90	4.00	0.38	2.47	1.90	-0.70	4.00	1.58	4.70	3.12	1
112	MODERN	-3.20	-5.90	-0.30	-4.82	-3.32	-1.57	-2.00	1.50	-3.28	3.50		0
113	MODERN	1.10	3.30	3.90	2.13	3.62	2.52	0.40	3.00	2.75	2.60	-0.15	2
114	MODERN	-2.40	-3.80	5.10	-3.08	0.42	1.07	-0.10	3.00	-0.58	3.10		0
115	MODERN	2.30	1.00	1.90	1.71	1.49	2.10	3.70	4.50	1.78	0.80	-0.98	1
116	MODERN	-4.30	-3.80	2.50	-4.05	-0.48	-0.72	1.90	6.00	-1.71	4.10		0
117	MODERN	0.30	-2.80	3.00	-1.41	0.19	1.83	0.90	3.50	0.22	2.60	2.38	1
118	MODERN	3.10	1.00	-2.30	2.05	-0.73	0.27	3.00	3.00	0.51	0.00		1
119	MODERN	8.00	6.50	10.00	7.25	8.25	9.00	3.20	2.50	8.17	-0.70		5
120	MODERN	0.00	0.70	-3.50	0.32	-1.56	-1.75	2.70	3.50	-1.01	0.80		0
121	MODERN	-0.80	-0.20	2.40	-0.47	1.36	1.26	0.20	2.00	0.82	1.80	0.98	1
122	MODERN	-4.70	-2.50	2.00	-3.56	-0.05	-0.94	0.40	4.50	-1.44	4.10		0
123	MODERN	2.30	-0.50	7.60	0.74	3.64	5.30	2.10	2.00	3.26	-0.10		2
124	MODERN	2.30	1.10	3.00	1.73	2.02	2.62	-0.10	1.50	2.12	1.60	-0.52	2
125	MODERN	-1.20	0.70	4.30	-0.26	2.59	1.65	2.90	4.00	1.35	1.10	-0.25	1
126	MODERN	-4.50	-8.50	2.20	-6.72	-3.43	-0.95	-1.70	3.00	-3.75	4.70		0
127	MODERN	0.10	-4.00	5.50	-1.90	1.11	2.94	1.70	2.00	0.78	0.30	-0.48	1
128	MODERN	0.90	-0.50	1.10	0.19	0.30	1.00	-0.80	1.00	0.50	1.80	1.30	1
129	MODERN	1.10	-4.40	1.80	-1.89	-1.30	1.48	0.40	2.00	-0.59	1.60		0
130	MODERN	2.50	-1.90	1.70	0.24	-0.01	2.07	-1.60	5.00	0.77	6.60	5.83	1
131	MODERN	-2.00	2.00	6.70	0.00	4.38	2.40	5.00	4.50	2.27	-0.50		2
132	MODERN	2.70	1.40	6.80	2.02	3.81	4.62	1.10	2.00	3.44	0.90	-2.54	2
133	MODERN	4.00	1.00	5.00	2.50	3.00	4.50	3.30	3.00	3.33	-0.30		2
134	MODERN	-4.60	-8.20	3.40	-6.78	-2.46	0.20	0.00	5.00	-2.99	5.00		0
135	MODERN	5.70	6.30	10.00	6.01	8.29	8.06	3.60	2.50	7.50	-1.10		4
136	MODERN	4.60	5.30	7.40	4.95	6.38	6.03	0.70	3.00	5.79	2.30	-3.49	3
137	MODERN	0.20	3.30	4.60	1.77	3.93	2.34	1.90	4.00	2.67	2.10	-0.57	2
138	MODERN	-4.20	0.10	4.20	-1.93	2.19	0.33	2.00	5.50	0.25	3.50	3.25	1
139	MODERN	3.30	3.60	4.10	3.45	3.86	3.70	4.10	4.00	3.67	-0.10		2
140	MODERN	2.40	3.20	2.80	2.84	3.00	2.62	3.40	5.00	2.83	1.60	-1.23	2
141	MODERN	0.80	-0.40	1.40	0.28	0.65	1.11	-0.20	2.00	0.70	2.20	1.50	1
142	MODERN	-1.40	-1.40	3.20	-1.40	1.87	1.35	2.40	3.00	0.81	0.60	-0.21	1
143	MODERN	1.90	-3.10	2.90	-0.53	-0.01	2.40	1.60	4.00	0.64	2.40	1.76	1

OLDER MEDIUM QUALITY NON-GREEN BUILDING (REGIONAL LOCATION)

144	MODERN	-3.00	-2.20	3.40	-2.62	0.67	0.09	0.10	3.00	-0.63	2.90	0
145	MODERN	-1.50	-2.70	0.00	-1.97	-1.35	-0.91	-0.30	3.00	-1.42	3.30	0
146	MODERN	5.50	7.00	8.00	6.20	7.57	6.85	1.40	3.50	6.89	2.10	-4.79	4
147	MODERN	0.80	-5.00	2.60	-2.37	-1.50	1.71	-0.40	2.00	-0.79	2.40	0
148	MODERN	0.30	6.00	5.70	3.33	5.85	3.23	7.40	8.50	4.17	1.10	-3.07	3
149	MODERN	3.80	4.00	3.00	3.90	3.52	3.40	-0.30	3.00	3.61	3.30	-0.31	2
150	MODERN	-4.90	-4.80	1.50	-4.85	-1.62	-1.67	2.00	2.50	-2.70	0.50	0
151	MODERN	3.90	4.50	10.00	4.24	7.28	7.37	6.60	7.00	6.34	0.40	-5.94	4
152	MODERN	-4.00	-0.10	4.40	-2.26	2.29	0.01	-2.90	2.50	-0.02	5.40	0
153	MODERN	-7.00	-0.20	1.20	-3.80	0.47	-3.29	-0.30	3.50	-2.28	3.80	0
154	MODERN	3.60	1.80	2.80	2.76	2.32	3.21	2.60	4.50	2.77	1.90	-0.87	2
155	MODERN	3.50	-1.20	0.40	1.67	-0.32	2.14	1.00	3.50	1.26	2.50	1.24	1
156	MODERN	2.10	-2.60	3.20	-0.13	0.30	2.62	3.60	4.00	0.94	0.40	-0.54	1
157	MODERN	4.80	0.80	4.20	3.12	2.75	4.50	0.20	3.50	3.51	3.30	-0.21	2
158	MODERN	-0.70	-1.80	0.40	-1.15	-0.44	-0.11	0.90	3.00	-0.53	2.10	0
159	MODERN	1.40	0.80	0.40	1.10	0.60	0.89	0.00	2.50	0.86	2.50	1.64	1
160	MODERN	-0.40	0.40	4.20	-0.05	2.45	1.80	4.30	2.00	1.39	-2.30	1
161	MODERN	1.20	1.50	4.00	1.35	2.78	2.60	1.60	3.00	2.25	1.40	-0.85	2
162	MODERN	1.60	5.80	7.10	3.58	6.49	4.35	1.90	4.00	4.80	2.10	-2.70	3
163	MODERN	5.00	1.50	3.30	3.32	2.50	4.09	5.10	6.00	3.31	0.90	-2.41	2
164	MODERN	1.30	4.10	3.90	2.70	4.00	2.65	0.30	2.00	3.12	1.70	-1.42	2
165	MODERN	-6.10	3.90	5.10	-1.26	4.51	-0.56	3.10	3.50	0.87	0.40	-0.47	1
166	MODERN	1.40	1.60	3.70	1.50	2.61	2.50	3.10	1.50	2.19	-1.60	2
167	MODERN	2.40	-1.50	-0.20	0.39	-0.86	1.09	1.40	1.00	0.19	-0.40	1
168	MODERN	0.30	-1.20	7.70	-0.53	3.47	4.56	0.70	2.50	2.59	1.80	-0.79	2
169	MODERN	0.50	1.50	-0.10	1.09	0.74	0.16	-3.10	4.00	0.67	7.10	6.43	1
170	MODERN	-0.70	3.70	3.40	1.82	3.56	1.49	-0.90	1.00	2.34	1.90	-0.44	2
171	MODERN	1.00	1.90	4.50	1.49	3.20	2.92	1.70	2.50	2.56	0.80	-1.76	2
172	MODERN	-1.60	1.60	8.40	0.00	4.92	3.28	-0.40	1.50	2.71	1.90	-0.81	2
173	MODERN	2.80	2.20	7.20	2.51	4.81	5.02	1.20	3.50	4.13	2.30	-1.83	3
174	MODERN	-5.30	-1.40	1.10	-3.37	-0.33	-2.61	0.20	1.00	-2.17	0.80	0
175	MODERN	-6.30	-2.00	6.00	-4.11	2.00	-0.02	0.70	1.50	-0.69	0.80	0
176	MODERN	2.20	-3.30	2.80	-0.76	-0.11	2.54	0.90	4.00	0.56	3.10	2.54	1
177	MODERN	2.70	0.30	3.00	1.50	1.65	2.85	2.40	0.50	2.00	-1.90	1
178	MODERN	4.10	0.80	4.80	2.39	2.87	4.47	5.60	6.50	3.25	0.90	-2.35	2

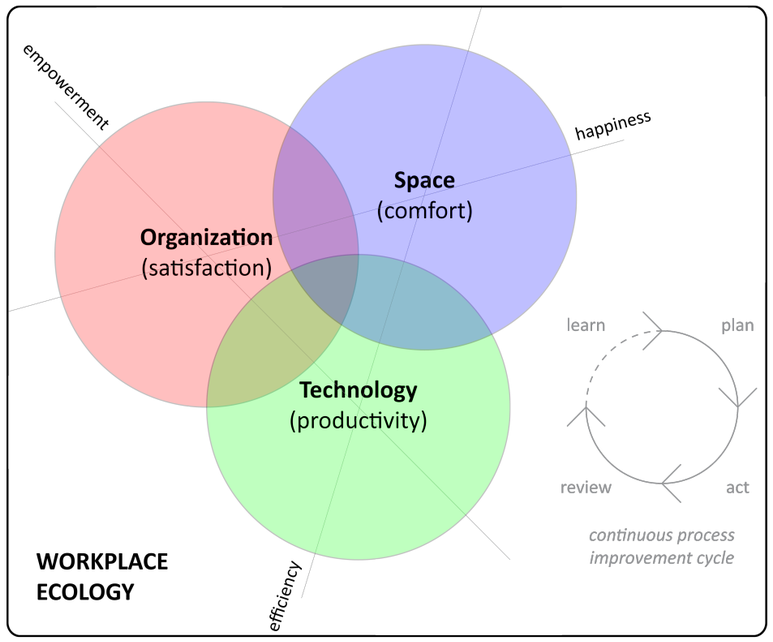
OLDER MEDIUM QUALITY NON-GREEN BUILDING (REGIONAL LOCATION)

SUMMARY ANALYSIS

RESPONSE RATE: 37.59% (minimum 30% required)

SURVEY POPULATION: 838

CONCEPTUAL FRAMEWORK:



AVERAGE OPINION X WEIGHT
N

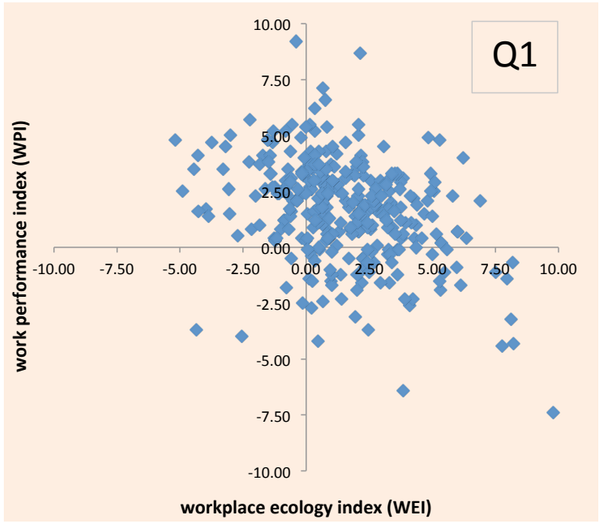
OPINION=1
N

WEIGHTING=5
N

RESEARCH PROPOSITIONS (RP):

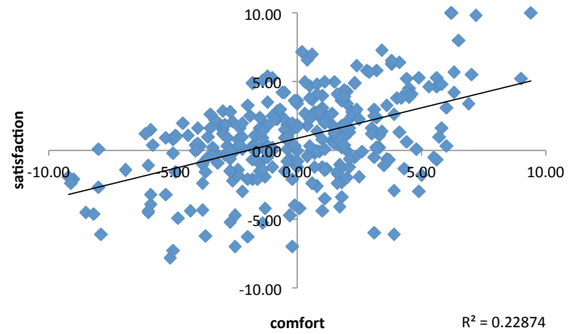
HEALTHY ECOSYSTEMS: *RP #1: at least three-quarters of the values for WEI and WPI must fall within quadrant Q1 for a balanced work 'ecosystem'**

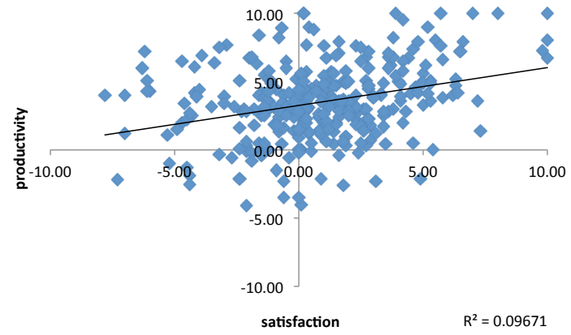
ECOSYSTEM ATTRIBUTES: *RP #2: the components of WEI have a significant positive correlation with each other, moderated by job complexity*

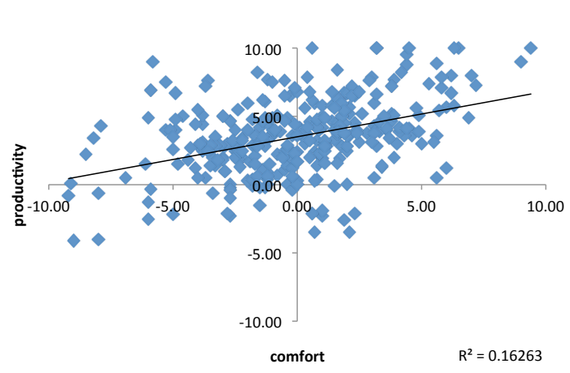


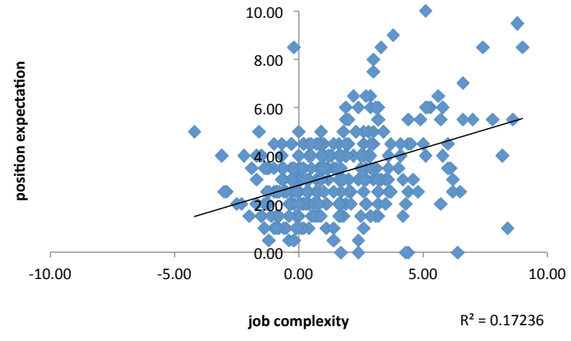
** the ratio of Q1 to Q1-4 can be used to rank the performance of workplaces*

RP #2 TESTS:





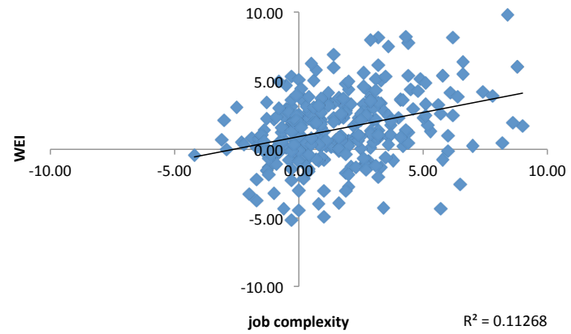


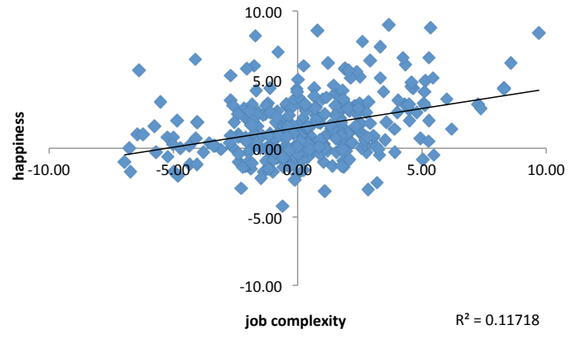


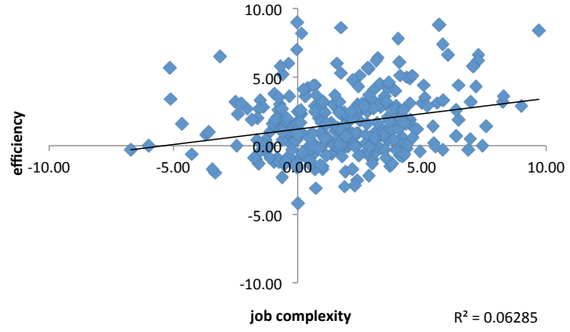
AVERAGE		0.86	-0.04	3.50	0.41	1.78	2.24	1.60	3.27	1.49	1.67	56.83%	1.36
												target 75%	
	building type	*satisfaction*	*comfort*	*productivity*	*happiness*	*efficiency*	*empowerment*	*complexity*	*expectation*	*WEI*	*WPI*	*RP #1 test*	*star rating*
1	MODERN	-0.90	-1.50	-1.50	-1.21	-1.50	-1.21	3.30	8.50	-1.31	5.20		0
2	MODERN	4.70	0.50	4.60	2.56	2.51	4.65	1.80	1.50	3.23	-0.30		2
3	MODERN	-4.50	-6.00	-1.30	-5.25	-3.70	-2.93	0.80	2.50	-3.97	1.70		0
4	MODERN	-1.20	-1.00	3.60	-1.11	1.51	1.14	1.10	1.00	0.52	-0.10		1
5	MODERN	0.10	-0.40	0.00	-0.16	-0.19	0.05	-1.20	2.00	-0.10	3.20		0
6	MODERN	-2.10	-9.00	-4.10	-5.69	-6.71	-3.08	-0.30	4.50	-5.19	4.80		0
7	MODERN	2.30	-0.80	2.20	0.67	0.72	2.25	4.40	4.50	1.21	0.10	-1.11	1
8	MODERN	0.70	1.40	4.70	1.05	3.10	2.77	0.30	2.00	2.32	1.70	-0.62	2
9	MODERN	4.90	-1.80	4.80	1.64	1.58	4.85	2.70	2.00	2.71	-0.70		2
10	MODERN	0.40	-5.80	9.00	-2.70	1.75	4.79	5.30	6.00	1.31	0.70	-0.61	1
11	MODERN	-1.00	1.70	1.90	0.23	1.80	0.39	2.20	6.50	0.79	4.30	3.51	1
12	MODERN	1.50	-3.00	2.00	-0.75	-0.50	1.75	1.70	1.50	0.17	-0.20		1
13	MODERN	-0.80	-0.20	1.30	-0.51	0.58	0.26	-0.20	3.50	0.11	3.70	3.59	1
14	MODERN	-0.20	-3.30	3.50	-1.67	0.40	1.72	4.20	1.50	0.20	-2.70		1
15	MODERN	0.40	-4.10	1.20	-2.09	-1.38	0.85	2.80	4.00	-0.88	1.20		0
16	MODERN	-0.30	-2.90	2.80	-1.60	-0.09	1.23	1.60	2.00	-0.16	0.40		0
17	MODERN	0.00	-2.50	2.50	-1.25	0.00	1.25	-1.00	2.50	0.00	3.50		0
18	MODERN	0.80	-2.40	2.40	-0.80	0.00	1.60	1.10	2.00	0.27	0.90	0.63	1
19	MODERN	-0.10	2.60	5.20	1.11	4.02	2.52	0.00	3.00	2.54	3.00	0.46	2
20	MODERN	4.50	4.50	4.10	4.50	4.30	4.29	2.00	3.00	4.36	1.00	-3.36	3
21	MODERN	-0.80	0.00	2.40	-0.38	1.37	1.09	-0.60	2.50	0.75	3.10	2.35	1
22	MODERN	2.80	0.70	6.00	1.67	3.58	4.66	3.00	5.00	3.36	2.00	-1.36	2
23	MODERN	5.40	-1.20	0.00	2.52	-0.61	3.09	5.20	6.00	1.77	0.80	-0.97	1

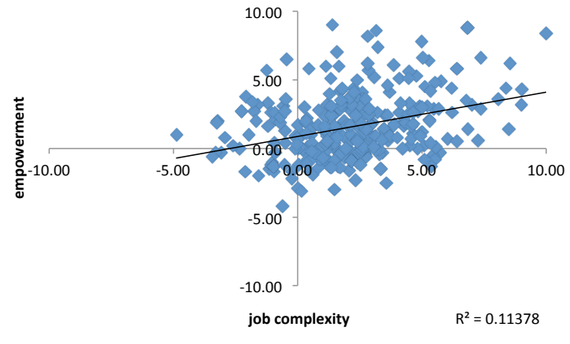
ALL CASE STUDIES (EXCLUDING PILOT): SORTED BY TYPE

24	MODERN	4.10	4.60	3.60	4.33	4.09	3.86	6.10	3.50	4.10	-2.60		3
25	MODERN	-1.50	-0.50	2.50	-1.00	1.00	0.50	-1.70	2.00	0.17	3.70	3.53	1
26	MODERN	0.00	2.00	0.00	1.02	0.99	0.00	0.00	1.50	0.67	1.50	0.83	1
27	MODERN	-1.40	-2.40	5.50	-1.88	1.71	2.08	-0.10	1.50	0.66	1.60	0.94	1
28	MODERN	4.30	2.00	2.80	3.19	2.40	3.58	-2.50	2.00	3.06	4.50	1.44	2
29	MODERN	-0.90	-3.80	4.40	-2.16	0.71	1.66	2.90	1.50	0.11	-1.40		1
30	MODERN	5.80	2.80	3.80	4.48	3.33	4.86	2.80	5.00	4.25	2.20	-2.05	3
31	MODERN	-3.40	1.80	6.40	-1.13	4.14	0.96	-0.70	3.50	1.21	4.20	2.99	1
32	MODERN	3.70	0.60	6.20	2.11	3.40	4.98	1.20	3.00	3.50	1.80	-1.70	2
33	MODERN	0.40	-1.40	3.10	-0.45	1.02	1.78	3.20	5.50	0.81	2.30	1.49	1
34	MODERN	0.10	-8.00	-4.00	-4.72	-6.00	-2.34	0.00	3.50	-4.45	3.50		0
35	MODERN	-0.60	-2.70	-2.30	-1.83	-2.50	-1.60	3.20	5.50	-2.01	2.30		0
36	MODERN	-2.30	1.80	2.80	-0.15	2.31	0.40	0.10	3.00	0.88	2.90	2.02	1
37	MODERN	1.90	-1.30	4.90	0.38	1.80	3.33	-0.30	3.00	1.84	3.30	1.46	1
38	MODERN	0.50	1.60	4.50	1.04	3.02	2.41	-1.00	1.00	2.14	2.00	-0.14	2
39	MODERN	0.30	-1.80	2.90	-0.83	0.37	1.60	-0.70	4.50	0.34	5.20	4.86	1
40	MODERN	2.60	3.90	2.00	3.29	3.12	2.34	-0.50	2.50	2.94	3.00	0.06	2
41	MODERN	-2.90	3.90	7.70	0.61	5.84	2.69	-0.30	2.50	3.10	2.80	-0.30	2
42	MODERN	0.20	-1.00	3.80	-0.41	1.45	2.08	3.00	7.50	1.06	4.50	3.44	1
43	MODERN	-1.20	2.10	5.20	0.51	3.69	2.20	0.90	5.00	2.16	4.10	1.94	2
44	MODERN	-0.80	-1.60	8.20	-1.13	5.49	5.08	0.20	2.00	3.74	1.80	-1.94	2
45	MODERN	-6.00	3.10	4.30	-1.88	3.72	-1.15	-1.50	4.00	0.14	5.50	5.36	1
46	MODERN	-1.30	1.20	2.80	-0.01	1.92	0.62	-1.90	3.50	0.83	5.40	4.57	1
47	MODERN	-1.50	-1.50	4.20	-1.50	1.54	1.48	0.00	3.00	0.55	3.00	2.45	1
48	MODERN	-2.20	-2.60	3.00	-2.39	0.11	0.20	1.00	4.50	-0.72	3.50		0
49	MODERN	0.60	4.40	8.80	2.76	6.86	5.74	-0.30	4.50	5.30	4.80	-0.50	3
50	MODERN	2.90	-3.00	1.80	-0.12	-0.63	2.34	-2.30	2.00	0.52	4.30	3.78	1
51	MODERN	1.80	0.40	3.70	1.14	2.10	2.73	0.90	4.50	1.99	3.60	1.61	1
52	MODERN	-2.10	-1.80	-0.10	-1.94	-0.95	-1.06	-1.20	3.50	-1.31	4.70		0
53	MODERN	0.80	1.00	4.20	0.90	2.83	2.72	-0.40	0.50	2.21	0.90	-1.31	2
54	MODERN	-7.00	-2.50	4.00	-4.97	0.71	-2.11	-1.70	4.00	-2.23	5.70		0
55	MODERN	-1.60	-4.90	4.00	-3.33	-0.22	1.48	0.20	4.50	-0.63	4.30		0
56	MODERN	2.70	-0.80	5.10	0.91	2.05	3.89	1.80	5.00	2.26	3.20	0.94	2
57	MODERN	-0.60	-0.30	1.60	-0.43	0.65	0.61	-0.60	3.00	0.29	3.60	3.31	1
58	MODERN	-3.20	-5.30	7.50	-4.37	1.44	3.02	0.20	4.50	0.16	4.30	4.14	1
59	MODERN	0.00	0.00	0.00	0.00	0.00	0.00	1.70	2.00	0.00	0.30		0
60	MODERN	-1.20	1.00	5.80	-0.05	3.34	2.39	-0.20	3.00	1.90	3.20	1.30	1
61	MODERN	-0.20	-3.30	1.40	-1.75	-1.11	0.55	1.00	4.00	-0.79	3.00		0
62	MODERN	-3.90	-5.90	6.90	-4.99	0.50	1.99	0.80	3.50	-0.79	2.70		0
63	MODERN	-1.00	-3.80	3.10	-2.37	-0.31	1.03	-1.00	4.50	-0.54	5.50		0
64	MODERN	-0.70	5.60	8.90	2.58	7.44	4.83	0.00	2.50	5.08	2.50	-2.58	3
65	MODERN	-0.50	2.30	6.50	0.82	4.53	3.04	1.90	2.00	2.81	0.10	-2.71	2
66	MODERN	0.20	3.20	4.00	1.70	3.60	2.10	0.50	1.50	2.47	1.00	-1.47	2
67	MODERN	-1.40	1.70	3.80	0.13	2.76	1.20	3.20	2.00	1.36	-1.20		1
68	MODERN	-2.40	1.60	1.60	-0.55	1.60	-0.50	1.30	4.00	0.15	2.70	2.55	1
69	MODERN	-1.90	-1.30	-0.20	-1.59	-0.78	-1.06	2.60	5.00	-1.15	2.40		0
70	MODERN	1.40	3.40	1.30	2.47	2.41	1.35	3.00	8.00	2.09	5.00	2.91	2
71	MODERN	-2.10	-2.00	0.30	-2.05	-0.83	-0.90	2.10	2.50	-1.26	0.40		0
72	MODERN	0.00	-1.20	0.90	-0.64	-0.36	0.39	-0.80	1.50	-0.23	2.30		0
73	MODERN	-4.70	-0.30	6.50	-2.39	3.36	1.59	0.80	4.50	0.98	3.70	2.72	1
74	MODERN	10.00	9.40	10.00	9.70	9.70	10.00	8.40	1.00	9.80	-7.40		5
75	MODERN	-6.10	-7.90	4.30	-6.96	-1.66	-1.01	-1.00	3.50	-3.21	4.50		0
76	MODERN	3.60	0.00	6.80	1.77	3.95	5.48	2.90	6.00	3.85	3.10	-0.75	2
77	MODERN	1.80	1.80	5.00	1.80	4.17	4.27	1.60	4.50	3.74	2.90	-0.84	2
78	MODERN	1.60	3.00	7.90	2.29	5.60	4.90	3.10	3.50	4.30	0.40	-3.90	3
79	MODERN	0.10	-2.50	2.80	-1.31	0.02	1.50	2.50	4.00	0.05	1.50	1.45	1
80	MODERN	1.90	1.40	5.80	1.66	3.92	4.08	2.60	1.00	3.29	-1.60		2
81	MODERN	-0.50	3.10	6.00	1.62	4.61	3.46	1.40	4.50	3.33	3.10	-0.23	2
82	MODERN	7.30	3.40	1.40	5.48	2.71	5.45	-0.50	1.00	4.68	1.50	-3.18	3
83	MODERN	0.30	-1.70	3.60	-0.69	0.85	1.87	2.00	3.00	0.66	1.00	0.34	1









84	MODERN	1.00	-2.20	2.00	-0.78	-0.05	1.57	7.00	5.50	0.25	-1.50	1
85	MODERN	-4.20	-1.30	6.10	-2.70	2.44	1.18	0.90	5.00	0.34	4.10	3.76	1
86	MODERN	2.90	-0.80	0.70	1.03	-0.12	1.89	0.80	1.50	0.93	0.70	-0.23	1
87	MODERN	-0.60	3.60	4.00	1.40	3.80	1.62	-1.30	2.50	2.25	3.80	1.55	2
88	MODERN	6.60	0.40	7.90	3.53	4.23	7.26	0.60	2.00	5.02	1.40	-3.62	3
89	MODERN	-1.30	4.30	3.60	1.50	3.93	1.29	4.00	3.50	2.25	-0.50		2
90	MODERN	4.20	4.40	9.50	4.31	6.98	7.02	3.20	1.50	6.12	-1.70		4
91	MODERN	-2.60	0.80	3.20	-0.88	2.00	0.34	1.90	5.50	0.49	3.60	3.11	1
92	MODERN	-1.90	-9.20	-0.80	-6.38	-5.14	-1.24	5.70	2.00	-4.34	-3.70		0
93	MODERN	1.90	0.00	0.30	0.98	0.15	1.12	2.30	5.00	0.75	2.70	1.95	1
94	MODERN	6.30	3.80	5.20	5.13	4.52	5.77	4.90	5.50	5.15	0.60	-4.55	3
95	MODERN	0.00	-1.00	4.00	-0.44	1.67	1.90	3.20	6.00	1.05	2.80	1.75	1
96	MODERN	4.60	5.60	0.50	5.09	3.08	2.60	4.10	4.00	3.60	-0.10		2
97	MODERN	-3.00	4.90	3.90	1.21	4.40	0.68	-0.20	8.50	2.14	8.70	6.56	2
98	MODERN	-1.80	5.00	3.00	1.56	3.95	0.69	-0.30	2.00	2.07	2.30	0.23	2
99	MODERN	2.60	1.10	3.00	1.85	2.00	2.79	0.40	4.00	2.21	3.60	1.39	2
100	MODERN	3.40	0.00	1.70	1.70	0.90	2.50	2.20	4.00	1.70	1.80	0.10	1
101	MODERN	1.60	-0.20	-0.40	0.69	-0.30	0.59	0.40	2.00	0.32	1.60	1.28	1
102	MODERN	-0.20	0.70	2.40	0.25	1.57	1.13	6.00	4.50	0.99	-1.50		1
103	MODERN	6.30	3.80	4.70	5.04	4.23	5.53	-0.80	2.50	4.93	3.30	-1.63	3
104	MODERN	1.90	-0.40	4.90	0.73	2.44	3.53	2.40	6.00	2.27	3.60	1.33	2
105	MODERN	-0.50	-1.20	3.30	-0.87	1.02	1.47	0.70	2.50	0.54	1.80	1.26	1
106	MODERN	4.40	1.90	6.70	3.18	4.39	5.56	0.10	2.00	4.39	1.90	-2.49	3
107	MODERN	-1.70	1.60	6.30	-0.10	4.29	2.76	-0.60	1.00	2.42	1.60	-0.82	2
108	MODERN	2.80	2.30	4.50	2.59	3.58	3.64	1.00	3.50	3.29	2.50	-0.79	2
109	MODERN	-1.80	-2.40	1.80	-2.10	-0.36	-0.07	0.80	2.00	-0.86	1.20		0
110	MODERN	7.00	0.60	10.00	3.90	5.45	8.50	1.40	0.50	5.97	-0.90		3
111	MODERN	-0.10	0.90	4.00	0.38	2.47	1.90	-0.70	4.00	1.58	4.70	3.12	1
112	MODERN	-3.20	-5.90	-0.30	-4.82	-3.32	-1.57	-2.00	1.50	-3.28	3.50		0
113	MODERN	1.10	3.30	3.90	2.13	3.62	2.52	0.40	3.00	2.75	2.60	-0.15	2
114	MODERN	-2.40	-3.80	5.10	-3.08	0.42	1.07	-0.10	3.00	-0.58	3.10		0
115	MODERN	2.30	1.00	1.90	1.71	1.49	2.10	3.70	4.50	1.78	0.80	-0.98	1
116	MODERN	-4.30	-3.80	2.50	-4.05	-0.48	-0.72	1.90	6.00	-1.71	4.10		0
117	MODERN	0.30	-2.80	3.00	-1.41	0.19	1.83	0.90	3.50	0.22	2.60	2.38	1
118	MODERN	3.10	1.00	-2.30	2.05	-0.73	0.27	3.00	3.00	0.51	0.00		1
119	MODERN	8.00	6.50	10.00	7.25	8.25	9.00	3.20	2.50	8.17	-0.70		5
120	MODERN	0.00	0.70	-3.50	0.32	-1.56	-1.75	2.70	3.50	-1.01	0.80		0
121	MODERN	-0.80	-0.20	2.40	-0.47	1.36	1.26	0.20	2.00	0.82	1.80	0.98	1
122	MODERN	-4.70	-2.50	2.00	-3.56	-0.05	-0.94	0.40	4.50	-1.44	4.10		0
123	MODERN	2.30	-0.50	7.60	0.74	3.64	5.30	2.10	2.00	3.26	-0.10		2
124	MODERN	2.30	1.10	3.00	1.73	2.02	2.62	-0.10	1.50	2.12	1.60	-0.52	2
125	MODERN	-1.20	0.70	4.30	-0.26	2.59	1.65	2.90	4.00	1.35	1.10	-0.25	1
126	MODERN	-4.50	-8.50	2.20	-6.72	-3.43	-0.95	-1.70	3.00	-3.75	4.70		0
127	MODERN	0.10	-4.00	5.50	-1.90	1.11	2.94	1.70	2.00	0.78	0.30	-0.48	1
128	MODERN	0.90	-0.50	1.10	0.19	0.30	1.00	-0.80	1.00	0.50	1.80	1.30	1
129	MODERN	1.10	-4.40	1.80	-1.89	-1.30	1.48	0.40	2.00	-0.59	1.60		0
130	MODERN	2.50	-1.90	1.70	0.24	-0.01	2.07	-1.60	5.00	0.77	6.60	5.83	1
131	MODERN	-2.00	2.00	6.70	0.00	4.38	2.40	5.00	4.50	2.27	-0.50		2
132	MODERN	2.70	1.40	6.80	2.02	3.81	4.62	1.10	2.00	3.44	0.90	-2.54	2
133	MODERN	4.00	1.00	5.00	2.50	3.00	4.50	3.30	3.00	3.33	-0.30		2
134	MODERN	-4.60	-8.20	3.40	-6.78	-2.46	0.20	0.00	5.00	-2.99	5.00		0
135	MODERN	5.70	6.30	10.00	6.01	8.29	8.06	3.60	2.50	7.50	-1.10		4
136	MODERN	4.60	5.30	7.40	4.95	6.38	6.03	0.70	3.00	5.79	2.30	-3.49	3
137	MODERN	0.20	3.30	4.60	1.77	3.93	2.34	1.90	4.00	2.67	2.10	-0.57	2
138	MODERN	-4.20	0.10	4.20	-1.93	2.19	0.33	2.00	5.50	0.25	3.50	3.25	1
139	MODERN	3.30	3.60	4.10	3.45	3.86	3.70	4.10	4.00	3.67	-0.10		2
140	MODERN	2.40	3.20	2.80	2.84	3.00	2.62	3.40	5.00	2.83	1.60	-1.23	2
141	MODERN	0.80	-0.40	1.40	0.28	0.65	1.11	-0.20	2.00	0.70	2.20	1.50	1
142	MODERN	-1.40	-1.40	3.20	-1.40	1.87	1.35	2.40	3.00	0.81	0.60	-0.21	1
143	MODERN	1.90	-3.10	2.90	-0.53	-0.01	2.40	1.60	4.00	0.64	2.40	1.76	1

144	MODERN	-3.00	-2.20	3.40	-2.62	0.67	0.09	0.10	3.00	-0.63	2.90	0
145	MODERN	-1.50	-2.70	0.00	-1.97	-1.35	-0.91	-0.30	3.00	-1.42	3.30	0
146	MODERN	5.50	7.00	8.00	6.20	7.57	6.85	1.40	3.50	6.89	2.10	-4.79	4
147	MODERN	0.80	-5.00	2.60	-2.37	-1.50	1.71	-0.40	2.00	-0.79	2.40	0
148	MODERN	0.30	6.00	5.70	3.33	5.85	3.23	7.40	8.50	4.17	1.10	-3.07	3
149	MODERN	3.80	4.00	3.00	3.90	3.52	3.40	-0.30	3.00	3.61	3.30	-0.31	2
150	MODERN	-4.90	-4.80	1.50	-4.85	-1.62	-1.67	2.00	2.50	-2.70	0.50	0
151	MODERN	3.90	4.50	10.00	4.24	7.28	7.37	6.60	7.00	6.34	0.40	-5.94	4
152	MODERN	-4.00	-0.10	4.40	-2.26	2.29	0.01	-2.90	2.50	-0.02	5.40	0
153	MODERN	-7.00	-0.20	1.20	-3.80	0.47	-3.29	-0.30	3.50	-2.28	3.80	0
154	MODERN	3.60	1.80	2.80	2.76	2.32	3.21	2.60	4.50	2.77	1.90	-0.87	2
155	MODERN	3.50	-1.20	0.40	1.67	-0.32	2.14	1.00	3.50	1.26	2.50	1.24	1
156	MODERN	2.10	-2.60	3.20	-0.13	0.30	2.62	3.60	4.00	0.94	0.40	-0.54	1
157	MODERN	4.80	0.80	4.20	3.12	2.75	4.50	0.20	3.50	3.51	3.30	-0.21	2
158	MODERN	-0.70	-1.80	0.40	-1.15	-0.44	-0.11	0.90	3.00	-0.53	2.10	0
159	MODERN	1.40	0.80	0.40	1.10	0.60	0.89	0.00	2.50	0.86	2.50	1.64	1
160	MODERN	-0.40	0.40	4.20	-0.05	2.45	1.80	4.30	2.00	1.39	-2.30	1
161	MODERN	1.20	1.50	4.00	1.35	2.78	2.60	1.60	3.00	2.25	1.40	-0.85	2
162	MODERN	1.60	5.80	7.10	3.58	6.49	4.35	1.90	4.00	4.80	2.10	-2.70	3
163	MODERN	5.00	1.50	3.30	3.32	2.50	4.09	5.10	6.00	3.31	0.90	-2.41	2
164	MODERN	1.30	4.10	3.90	2.70	4.00	2.65	0.30	2.00	3.12	1.70	-1.42	2
165	MODERN	-6.10	3.90	5.10	-1.26	4.51	-0.56	3.10	3.50	0.87	0.40	-0.47	1
166	MODERN	1.40	1.60	3.70	1.50	2.61	2.50	3.10	1.50	2.19	-1.60	2
167	MODERN	2.40	-1.50	-0.20	0.39	-0.86	1.09	1.40	1.00	0.19	-0.40	1
168	MODERN	0.30	-1.20	7.70	-0.53	3.47	4.56	0.70	2.50	2.59	1.80	-0.79	2
169	MODERN	0.50	1.50	-0.10	1.09	0.74	0.16	-3.10	4.00	0.67	7.10	6.43	1
170	MODERN	-0.70	3.70	3.40	1.82	3.56	1.49	-0.90	1.00	2.34	1.90	-0.44	2
171	MODERN	1.00	1.90	4.50	1.49	3.20	2.92	1.70	2.50	2.56	0.80	-1.76	2
172	MODERN	-1.60	1.60	8.40	0.00	4.92	3.28	-0.40	1.50	2.71	1.90	-0.81	2
173	MODERN	2.80	2.20	7.20	2.51	4.81	5.02	1.20	3.50	4.13	2.30	-1.83	3
174	MODERN	-5.30	-1.40	1.10	-3.37	-0.33	-2.61	0.20	1.00	-2.17	0.80	0
175	MODERN	-6.30	-2.00	6.00	-4.11	2.00	-0.02	0.70	1.50	-0.69	0.80	0
176	MODERN	2.20	-3.30	2.80	-0.76	-0.11	2.54	0.90	4.00	0.56	3.10	2.54	1
177	MODERN	2.70	0.30	3.00	1.50	1.65	2.85	2.40	0.50	2.00	-1.90	1
178	MODERN	4.10	0.80	4.80	2.39	2.87	4.47	5.60	6.50	3.25	0.90	-2.35	2
179	MODERN	4.90	2.30	-2.10	3.67	-0.02	1.40	9.00	8.50	1.68	-0.50	1
180	MODERN	0.10	-2.20	3.20	-1.10	0.64	1.80	4.40	5.50	0.48	1.10	0.62	1
181	MODERN	0.20	-3.40	2.00	-1.65	-0.63	1.15	0.40	2.50	-0.37	2.10	0
182	MODERN	2.50	2.20	6.50	2.34	4.35	4.57	1.60	2.00	3.76	0.40	-3.36	2
183	MODERN	1.30	2.10	5.70	1.69	4.05	3.63	1.20	4.00	3.15	2.80	-0.35	2
184	MODERN	0.00	-1.10	1.50	-0.55	0.18	0.74	-0.50	2.50	0.12	3.00	2.88	1
185	MODERN	3.00	-0.70	3.90	1.34	1.93	3.47	1.40	0.50	2.30	-0.90	2
186	MODERN	3.80	0.50	6.80	2.20	3.86	5.36	0.40	1.00	3.84	0.60	-3.24	2
187	MODERN	5.80	3.20	6.60	4.63	5.07	6.20	4.40	2.50	5.33	-1.90	3
188	MODERN	0.00	0.80	1.40	0.36	1.09	0.61	1.50	3.50	0.67	2.00	1.33	1
189	MODERN	0.20	-1.20	4.50	-0.50	1.77	2.44	-0.30	2.50	1.26	2.80	1.54	1
190	MODERN	2.00	-4.60	5.00	-1.63	0.09	3.62	2.40	0.00	0.65	-2.40	1
191	MODERN	3.40	6.90	4.90	5.07	5.86	4.14	3.30	3.00	5.01	-0.30	3
192	MODERN	-1.90	2.50	6.80	0.30	4.62	2.40	0.60	1.50	2.43	0.90	-1.53	2
193	MODERN	-3.50	1.10	3.20	-1.36	2.19	-0.24	-1.70	2.00	0.18	3.70	3.52	1
194	MODERN	5.30	4.90	5.10	5.12	5.00	5.20	3.10	6.00	5.11	2.90	-2.21	3
195	MODERN	0.00	-2.70	-0.20	-1.29	-1.39	-0.10	0.00	2.50	-0.91	2.50	0
196	MODERN	2.30	2.50	3.10	2.40	2.79	2.69	2.50	3.50	2.62	1.00	-1.62	2
197	MODERN	2.80	-2.70	4.70	0.11	0.91	3.71	0.90	3.00	1.57	2.10	0.53	1
198	MODERN	3.40	2.00	2.50	2.68	2.21	3.00	0.90	3.00	2.63	2.10	-0.53	2
199	MODERN	-1.50	-2.70	-0.40	-2.10	-1.56	-0.96	-1.30	3.50	-1.54	4.80	0
200	MODERN	1.60	-3.50	2.90	-1.03	-0.82	2.16	-0.90	2.50	0.03	3.40	3.37	1
201	MODERN	2.80	0.90	2.30	1.96	1.68	2.55	-0.20	0.50	2.08	0.70	-1.38	2
202	MODERN	10.00	6.20	6.70	8.31	6.47	8.38	4.40	0.00	7.75	-4.40	4
203	MODERN	0.20	3.20	10.00	1.90	7.06	6.40	5.80	6.00	5.36	0.20	-5.16	3

204	MODERN	1.90	-2.90	1.00	-0.39	-0.97	1.48	1.60	2.00	0.05	0.40	0.35	1
205	MODERN	6.50	3.80	7.20	5.36	5.69	6.84	8.80	9.50	5.99	0.70	-5.29	3
206	MODERN	-2.40	0.60	-2.10	-0.83	-0.65	-2.25	2.70	3.00	-1.22	0.30		0
207	MODERN	1.20	-3.00	5.00	-1.16	1.00	3.33	-1.50	1.50	1.06	3.00	1.94	1
208	MODERN	6.20	2.40	4.00	4.56	3.30	5.11	4.50	4.50	4.36	0.00		3
209	MODERN	3.30	-2.00	4.00	0.89	1.20	3.64	0.60	2.00	1.95	1.40	-0.55	1
210	MODERN	1.60	-2.30	2.40	-0.22	0.11	1.98	1.70	3.50	0.64	1.80	1.16	1
211	MODERN	2.70	0.70	0.30	1.86	0.50	1.71	-1.40	1.00	1.41	2.40	0.99	1
212	MODERN	-4.40	1.00	-1.90	-1.81	-0.43	-3.22	2.00	3.00	-1.84	1.00		0
213	MODERN	6.40	4.10	4.20	5.29	4.15	5.33	2.00	4.50	4.93	2.50	-2.43	3
214	MODERN	1.10	-4.90	6.70	-1.83	0.96	3.87	1.70	0.00	1.01	-1.70		1
215	MODERN	3.00	3.10	3.80	3.05	3.42	3.33	0.80	2.50	3.26	1.70	-1.56	2
216	MODERN	5.30	5.60	3.60	5.45	4.60	4.46	5.10	10.00	4.84	4.90	0.06	3
217	MODERN	9.80	7.20	7.30	8.57	7.25	8.55	6.20	3.00	8.13	-3.20		5
218	MODERN	1.60	-1.50	3.10	0.05	0.74	2.33	3.70	2.50	1.03	-1.20		1
219	MODERN	7.20	0.20	3.60	4.58	2.21	5.53	4.80	2.50	4.23	-2.30		3
220	MODERN	5.00	0.30	5.60	2.91	3.22	5.30	6.40	0.00	3.86	-6.40		2
221	MODERN	1.00	-3.60	7.60	-1.13	2.31	4.23	0.00	2.00	1.84	2.00	0.16	1
222	MODERN	2.50	-1.00	7.50	0.75	3.25	5.00	3.00	4.50	3.00	1.50	-1.50	2
223	MODERN	-0.60	2.10	-3.50	0.67	-0.94	-2.08	3.80	9.00	-0.82	5.20		0
224	MODERN	2.80	-2.70	4.70	0.11	0.91	3.71	0.90	4.00	1.57	3.10	1.53	1
225	MODERN	3.40	2.00	2.80	2.66	2.37	3.11	0.90	3.00	2.70	2.10	-0.60	2
226	MODERN	-1.50	-2.70	-0.40	-2.10	-1.56	-0.96	-1.30	3.50	-1.54	4.80		0
227	MODERN	1.60	-4.00	2.90	-1.29	-1.11	2.16	-0.90	2.50	-0.15	3.40		0
228	MODERN	2.80	0.90	2.30	1.96	1.68	2.55	-0.20	0.50	2.08	0.70	-1.38	2
229	MODERN	10.00	6.20	8.00	8.31	7.18	9.02	4.30	0.00	8.20	-4.30		5
230	MODERN	0.20	3.20	10.00	1.90	7.06	6.40	5.80	6.00	5.36	0.20	-5.16	3
231	MODERN	1.90	-2.90	1.00	-0.39	-1.00	1.48	1.60	1.50	0.04	-0.10		1
232	MODERN	6.50	3.80	7.20	5.36	5.69	6.84	8.80	9.50	5.99	0.70	-5.29	3
233	MODERN	-2.40	0.60	-2.10	-0.83	-0.65	-2.25	2.70	3.00	-1.22	0.30		0
234	MODERN	1.20	-3.00	5.00	-1.16	1.00	3.33	-1.50	1.50	1.06	3.00	1.94	1
235	MODERN	-0.50	5.50	3.10	2.13	4.12	1.34	5.10	4.00	2.49	-1.10		2
236	MODERN	-1.20	0.00	0.00	-0.60	0.00	-0.60	-4.20	5.00	-0.40	9.20		0
237	MODERN	1.10	-1.60	0.60	-0.33	-0.53	0.84	-1.40	1.00	-0.02	2.40		0
238	MODERN	0.40	-2.30	1.30	-0.97	-0.38	0.89	-0.80	2.50	-0.14	3.30		0
239	MODERN	5.00	1.10	4.90	3.05	3.08	4.95	0.90	3.50	3.70	2.60	-1.10	2
240	GREEN	1.20	3.00	3.10	2.09	3.05	2.16	2.70	2.00	2.43	-0.70		2
241	GREEN	1.50	-0.20	1.90	0.71	0.91	1.70	2.90	6.50	1.12	3.60	2.48	1
242	GREEN	2.30	0.50	3.20	1.41	1.85	2.74	1.40	2.50	2.00	1.10	-0.90	2
243	GREEN	-4.40	-4.30	2.70	-4.35	-0.76	-0.53	-1.20	2.50	-1.84	3.70		0
244	GREEN	-1.60	-3.70	0.50	-2.72	-1.63	-0.49	0.40	3.00	-1.62	2.60		0
245	GREEN	1.60	2.10	3.60	1.84	2.88	2.59	-0.10	1.00	2.43	1.10	-1.33	2
246	GREEN	4.20	-0.50	6.50	1.78	3.00	5.39	-1.30	2.00	3.38	3.30	-0.08	2
247	GREEN	5.20	9.00	9.00	7.37	9.00	7.37	2.90	1.50	7.96	-1.40		4
248	GREEN	0.30	-3.90	3.00	-1.75	-0.37	1.65	6.00	3.50	-0.14	-2.50		0
249	GREEN	-1.10	3.50	5.00	1.32	4.25	2.11	1.70	4.00	2.59	2.30	-0.29	2
250	GREEN	0.00	-1.30	2.80	-0.57	0.90	1.33	-1.40	2.00	0.57	3.40	2.83	1
251	GREEN	-0.50	-3.60	2.50	-2.21	-0.08	1.38	-1.40	3.50	-0.19	4.90		0
252	GREEN	3.80	4.20	8.20	4.00	6.39	6.20	2.60	2.50	5.58	-0.10		3
253	GREEN	0.50	-4.00	0.50	-1.95	-1.75	0.50	-0.90	1.50	-1.08	2.40		0
254	GREEN	-2.70	-8.00	-0.60	-5.52	-5.11	-1.82	3.40	5.00	-4.27	1.60		0
255	GREEN	3.60	1.80	6.00	2.61	4.03	5.00	7.80	5.50	3.91	-2.30		2
256	GREEN	2.60	-3.50	1.40	-0.86	-1.13	1.94	0.00	4.00	-0.08	4.00		0
257	GREEN	0.10	1.10	1.60	0.59	1.35	0.83	1.70	3.00	0.92	1.30	0.38	1
258	GREEN	-6.20	-3.70	7.20	-5.02	1.62	-0.04	0.30	3.00	-1.23	2.70		0
259	GREEN	-1.40	-6.90	0.50	-4.12	-3.12	-0.44	6.50	2.50	-2.55	-4.00		0
260	GREEN	4.20	-0.60	2.00	1.75	0.61	3.15	0.90	1.50	1.83	0.60	-1.23	1
261	GREEN	2.10	2.00	3.60	2.05	2.82	2.85	5.70	5.50	2.58	-0.20		2
262	GREEN	1.50	-5.90	6.90	-2.41	0.70	4.44	2.50	1.50	0.94	-1.00		1
263	GREEN	1.80	-1.20	0.60	0.40	-0.13	1.12	0.30	2.50	0.48	2.20	1.72	1

264	GREEN	-2.10	-0.20	0.60	-1.09	0.12	-0.92	2.60	4.00	-0.64	1.40		0
265	GREEN	2.00	-0.20	3.60	1.09	2.15	2.85	2.50	4.00	2.10	1.50	-0.60	2
266	GREEN	-1.40	1.10	2.50	-0.16	1.74	0.36	1.10	3.50	0.62	2.40	1.78	1
267	GREEN	1.10	-1.70	2.10	-0.42	0.00	1.59	0.80	2.00	0.35	1.20	0.85	1
268	GREEN	1.50	-0.50	4.70	0.49	2.34	3.27	-0.10	2.50	2.08	2.60	0.52	2
269	GREEN	0.20	1.80	5.00	1.00	3.49	2.73	3.60	3.50	2.44	-0.10		2
270	GREEN	3.00	2.40	3.80	2.70	3.08	3.39	0.60	2.00	3.05	1.40	-1.65	2
271	GREEN	2.30	-0.90	4.00	0.79	1.74	3.17	8.60	5.50	1.93	-3.10		1
272	GREEN	5.10	-1.40	6.20	2.01	2.68	5.66	2.90	4.50	3.50	1.60	-1.90	2
273	GREEN	1.70	0.00	3.60	0.86	1.80	2.64	0.10	1.00	1.77	0.90	-0.87	1
274	GREEN	0.90	-5.30	4.00	-2.55	-0.90	2.54	1.90	4.00	-0.37	2.10		0
275	GREEN	1.00	5.70	5.40	3.25	5.55	3.13	-0.10	1.00	3.96	1.10	-2.86	2
276	GREEN	0.90	-1.40	3.50	-0.34	1.10	2.33	2.40	3.00	1.04	0.60	-0.44	1
277	GREEN	5.70	2.90	7.60	4.04	5.12	6.78	3.50	2.00	5.28	-1.50		3
278	GREEN	-1.10	-6.00	4.90	-4.04	-0.49	2.53	-1.20	0.50	-0.64	1.70		0
279	GREEN	-2.40	-9.10	0.10	-5.75	-4.65	-1.19	1.60	3.00	-3.88	1.40		0
280	GREEN	-2.10	-1.60	2.80	-1.84	0.50	0.35	-1.10	1.50	-0.34	2.60		0
281	GREEN	3.10	6.00	1.20	4.48	3.57	2.18	3.20	2.50	3.40	-0.70		2
282	GREEN	0.00	-1.70	1.50	-0.86	-0.24	0.70	-0.30	3.00	-0.16	3.30		0
283	GREEN	1.00	-0.40	2.60	0.30	1.03	1.76	3.20	3.00	1.02	-0.20		1
284	GREEN	2.50	3.10	0.50	2.83	1.90	1.49	-3.00	2.50	2.09	5.50	3.41	2
285	GREEN	3.60	-0.10	7.10	1.82	3.63	5.35	4.20	3.00	3.62	-1.20		2
286	GREEN	-4.40	-6.00	-2.50	-5.22	-4.27	-3.43	-0.60	3.50	-4.31	4.10		0
287	GREEN	-5.20	-2.70	-1.00	-4.02	-1.86	-3.24	1.90	4.50	-3.07	2.60		0
288	GREEN	2.00	1.10	2.80	1.53	1.94	2.42	0.70	4.50	1.96	3.80	1.84	1
289	GREEN	0.70	1.70	4.30	1.23	3.16	2.82	6.20	2.50	2.47	-3.70		2
290	GREEN	0.30	0.50	2.00	0.40	1.16	1.07	1.60	4.00	0.86	2.40	1.54	1
291	GREEN	-4.10	1.70	3.90	-1.47	2.87	-0.23	-2.20	4.00	0.35	6.20	5.85	1
292	GREEN	5.30	-1.00	4.90	2.09	1.79	5.11	-0.80	1.50	2.97	2.30	-0.67	2
293	GREEN	0.00	-4.10	4.40	-2.07	0.48	2.40	0.50	3.50	0.33	3.00	2.67	1
294	GREEN	0.90	-2.80	-2.10	-0.86	-2.41	-0.70	2.30	5.00	-1.32	2.70		0
295	GREEN	0.30	-0.10	2.30	0.12	1.08	1.20	0.50	4.00	0.79	3.50	2.71	1
296	GREEN	-7.80	-5.10	4.00	-6.45	-0.60	-1.96	1.00	2.50	-3.02	1.50		0
297	GREEN	1.40	-1.40	4.70	-0.02	1.65	3.07	0.10	3.50	1.57	3.40	1.83	1
298	GREEN	4.80	5.80	7.90	5.28	6.95	6.42	0.50	4.50	6.23	4.00	-2.23	4
299	GREEN	-0.80	0.00	1.70	-0.37	0.85	0.56	-0.20	3.50	0.36	3.70	3.34	1
300	GREEN	4.10	1.60	3.90	2.82	2.74	4.00	0.80	2.00	3.18	1.20	-1.98	2
301	GREEN	0.40	1.90	3.80	1.14	2.86	2.10	3.70	2.50	2.03	-1.20		2
302	GREEN	3.90	1.90	5.40	2.91	3.67	4.65	1.80	3.00	3.75	1.20	-2.55	2
303	GREEN	-0.80	-0.40	2.90	-0.59	1.15	1.03	-0.70	3.00	0.52	3.70	3.18	1
304	GREEN	-0.20	-5.00	3.50	-2.70	-0.75	1.73	3.50	3.00	-0.58	-0.50		0
305	GREEN	4.20	6.30	5.80	5.28	6.04	5.04	6.60	5.50	5.47	-1.10		3
306	GREEN	1.00	-4.90	4.80	-1.69	0.17	2.82	8.20	4.00	0.47	-4.20		1
307	GREEN	2.00	-2.20	2.50	-0.01	0.25	2.25	4.10	4.50	0.85	0.40	-0.45	1
308	GREEN	1.80	1.90	-2.60	1.85	-0.33	-0.47	3.60	3.00	0.35	-0.60		1
309	GREEN	-0.40	-3.40	-0.60	-1.93	-2.03	-0.50	2.70	6.50	-1.50	3.80		0
310	GREEN	-0.90	-3.20	1.80	-2.05	-0.70	0.45	5.80	4.00	-0.77	-1.80		0
311	GREEN	1.40	1.50	5.60	1.45	3.67	3.62	4.60	3.00	2.94	-1.60		2
312	GREEN	1.20	-6.10	1.50	-2.61	-2.26	1.36	3.10	3.50	-1.18	0.40		0
313	GREEN	5.20	4.40	4.10	4.80	4.25	4.66	2.60	3.00	4.57	0.40	-4.17	3
314	GREEN	-7.30	-5.00	-2.20	-6.22	-3.58	-4.87	1.00	3.50	-4.91	2.50		0
315	GREEN	0.10	4.80	5.60	2.45	5.21	2.88	2.90	3.50	3.52	0.60	-2.92	2